The JERICO-DS project is funded by the European Commission's H2020 Framework Programme under grant agreement No. 951799. Project coordinator: Ifremer, France.

JERICO-DS DELIVERABLE

Joint European Research Infrastructure of Coastal Observatories - Design Study

DELIVERABLE #, WP# and full title	JERICO-DS D5.1 - WP5 - "Conceptual Design Model of JERICO-RI"
5 Key words	Governance, access policies, service provision, ontology, observatory network
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Submission date (dd/mm/yyyy)	31/01/2024

Nature

☐ **R = Report,** ☐ **P = Prototype,** ☐ **D= Demonstrator,** ☐ **O = Other**

Dissemination level:

x PU ☐ **PP** ☐ **RE** ☐ **CO**

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GRANT N°: 951799
PROJECT ACRONYME: JERICO-DS
PROJECT NAME: Joint European Research Infrastructure network of Coastal Observatories - Design Study
COORDINATOR: Laurent DELAUNEY - Ifremer, France - design.jerico@ifremer.fr

DOCUMENT TECHNICAL DESCRIPTION

Document ID	JERICO-DS-WP5-D5.1-310124_V1.1

REVISION HISTORY

Revision	Date	Modification	Author
V1.0	05/10/2023		Henning Wehde
V1.1	31/01/2023	Minor corrections	Henning Wehde, Laurent Delauney

APPROVALS

	Name	Organisation	Date	Visa
Coordinator	Delauney Laurent	Ifremer	31/01/2024	X
WP Leaders	Delauney Laurent	Ifremer	31/01/2024	X

Diffusion list

Consortium beneficiaries	Third parties	Associated Partners	other
x			

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EXECUTIVE SUMMARY

This Deliverable addresses the conceptual architecture of the JERICO-RI and describes its components and their connection among each other.

The JERICO-RI will be a Distributed Research Infrastructure (DRI) composed of access provision to advanced multi-platform coastal observatories, and accompanying international leading expertise. It will enable access to harmonised interdisciplinary data, knowledge exchange as well as provide training and education so as to enable optimised answers to the Grand Challenges and connected societal and research needs.

The Components for the JERICO-RI consists of: (a) the central hub, (b) the coastal observatory network, *i.e*. systems which consist of multidisciplinary observational platforms and stations that are available for scientific teams and industry partners to lead research and experiments, as well as (c) the JERICO-CORE. JERICO-CORE is envisioned as the unified, virtual central hub of JERICO to discover, access, manage and interact with JERICO resources including services, datasets, software, best practices, manuals, publications, organisations, projects, observatories, equipment, data servers, e-libraries, support, training, and similar assets and Technical Expert Centers and also Thematic Expert Centers.

The central management of the JERICO-RI will be conducted by the Director General and the Executive Committee, which will be supported by the Central Office, that performs the managerial function of planning, organising, directing and controlling. A crucial process for the functioning of the JERICO-RI is the undisturbed interaction between the components, ensuring an optimal effectiveness of work and processes serving the stakeholders.

1. Introduction

The focal point of this Deliverable is to draft the conceptual design of the functioning of the JERICO-RI. That is conducted *via* the integration of the Hardware part with the conceptual Design of the Software part, aiming to develop a holistic conceptual model for the JERICO-RI from the sensors to the provision of information and service to users.

Proposing an operational structure to be generated at the level of the Central hub as well as defining the role of both the Technical Expert Centers (Hardware systems) and also the Thematic Expert Centers (Virtual systems) are essential in order to optimise the scientific operations of the platform types included.

Nationally established systems that are already operational make for a crucial integration background, in order to design a distributed multi-platform infrastructure.

JERICO-RI is an integrated, pan-European multidisciplinary and multi-platform Research Infrastructure dedicated to a holistic appraisal of coastal marine system changes. The aim is to seamlessly bridge existing continental, atmospheric and open-ocean RIs, thus filling a key gap in the European landscape. JERICO-RI aims to establish the framework upon which coastal marine systems are observed, analysed, understood and forecasted, and in turn, that enables open-access to state-of-the-art and innovative facilities, resources, FAIR data and fit-for-purpose services, ultimately fostering international science collaboration.

2. Context for the JERICO-RI

Coastal observations are crucial for addressing several grand challenges facing society today, including climate change, food security, and disaster risk reduction. One of the key challenges posed by climate change is rising sea levels, which threatens to inundate coastal areas and infrastructures. Coastal observations can provide valuable data on sea level changes, wave patterns, and ocean currents, which can help to inform coastal management and planning strategies.

In terms of food security, coastal observations can support the sustainable management of fisheries and aquaculture, which are critical sources of food and income for many coastal communities. By monitoring ocean conditions such as temperature, salinity, and nutrient levels, researchers can better understand the dynamics of marine ecosystems and develop more effective strategies for managing and conserving fish stocks.

Disaster risk reduction is another area where coastal observations can have a significant impact. By providing real-time data on weather conditions, sea levels,

and other factors, coastal observations can help to anticipate and mitigate the impacts of natural disasters such as hurricanes, storm surges, and tsunamis.

In the context of offshore wind, coastal observations can contribute to the safe and sustainable development of wind farms. By monitoring ocean conditions such as wind speed and direction, wave heights, and water currents, offshore wind developers can optimise the location and design of wind turbines and other infrastructures, helping to minimise the environmental impact of these projects.

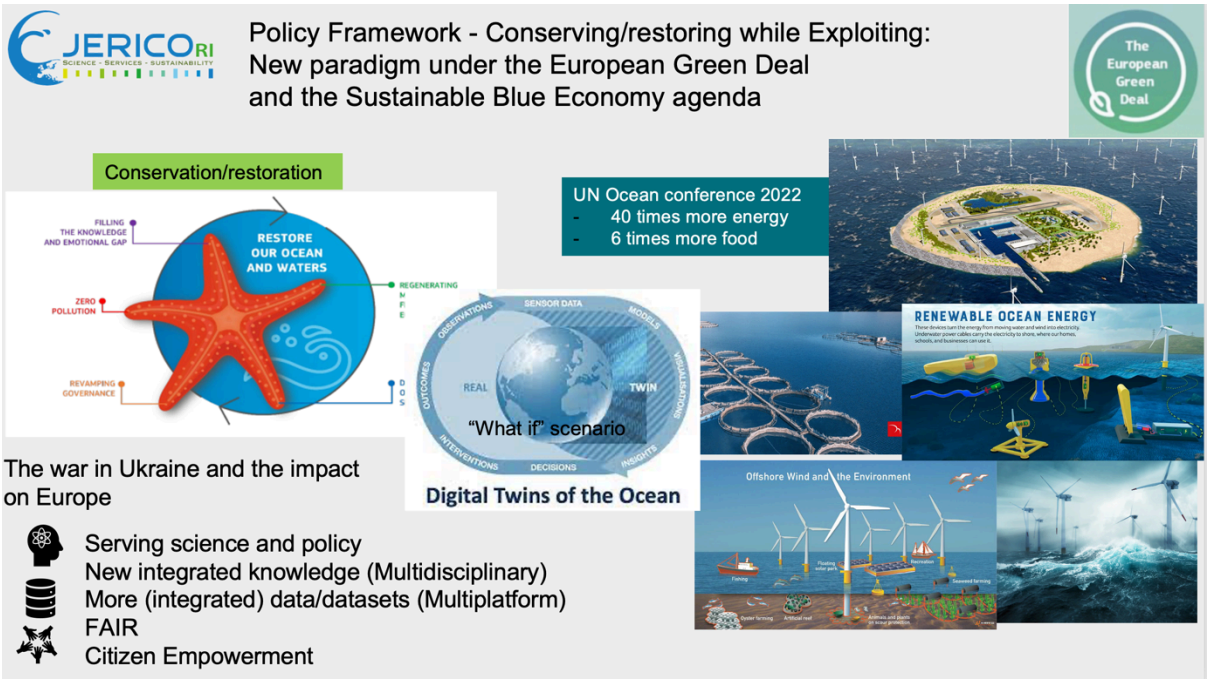

Figure 1: New paradigm under the European Green Deal and the sustainable Blue Economy agenda

Overall, coastal observations play a critical role in addressing a range of grand challenges facing society today. By providing valuable data and insights, these observations can support the development of more sustainable and resilient coastal communities and ecosystems, which will contribute to the aims of the Green Deal goals. The Green Deal is a comprehensive package of measures proposed by the European Commission in 2019 to achieve carbon neutrality and reduce greenhouse gas emissions by 55% by 2030. The deal includes a wide range of initiatives and policies to transform the European Union's economy, society, and environment to a more sustainable and resilient state. The Green Deal is centred on the idea of a circular economy that promotes the sustainable use of resources, including renewable energy, sustainable transport, and the reduction of waste and pollution. It also aims to foster the development of new industries and jobs in green technologies and services. The European Commission has committed to investing at least 25% of the EU budget in climate-related actions and has set up a fund of 100 billion euros to support the transition to a sustainable and carbon-neutral economy. In addition, the recently launched Repower EU is a comprehensive and ambitious initiative to transition to a renewable energy economy in the EU. By

achieving 100% renewable energy by 2040, the EU can lead the way in addressing the urgent challenges of climate change and securing a sustainable energy future. This transition has to be executed in a way that takes into consideration the existing directives that require a good environmental status of the oceans. With that in mind, the JERICO-RI conceptual model is aiming to optimise the input for the sustainable development of the coastal environment in Europe, especially the part that is under specific pressure because of the challenges upcoming.

3. The components of the JERICO-RI

a. The central organisation

The JERICO-RI will be a Distributed Research Infrastructure that collates world leading research expertise, observational facilities and the seamless provision of data and knowledge. To this end, we are aiming for the establishment of an ERIC (European Research Infrastructure Consortium) as a legal identity.

To clearly define the terminology used in the 2024 ESFRI Roadmap application and avoid confusion between partners, JERICO-RI is developing an ontology to specifically identify key terms and provide a simple definition of those terms.

Although the ontology is still in development, this document will use the following ontology terms as currently defined.

Governance: the system by which an organisation makes and implements decisions to achieve its goals.

Assembly of Members: one representative from each Member State (the national delegate) that may be accompanied by one or more advisors. The national delegate is appointed by the Member State.

Scientific, Technical and Ethical Advisory Committee: a collegial body appointed according to specific rules to provide advice to the Assembly of Members.

Director General: the legally responsible Head of JERICO-RI appointed by the Assembly of Members for a fixed period.

Executive Committee: a collegial body elected from their peers, according to specific rules, for the operation and management of the JERICO-RI.

Office: performs the managerial function of planning, organising, directing and controlling. These managerial functions are related to office management. They are needed to achieve office objectives. An office can be virtual or physical.

Expert Center: a group of experts responsible for discussion and strategy within some specific key scientific or technological domains, needed for activities and the generation and operation of specific centres. An expert centre can be virtual or physical.

Services: actions and activities carried out for the benefit of targeted users and providing assistance to these users. They can be internal if addressing internal needs of the JERICO-RI, or external when addressing JERICO-RI external users' needs.

The highest level of governance in JERICO-RI will be the **Assembly of Members** who have the ultimate decision-making powers of JERICO-RI. The Assembly of Members will be advised by the **Scientific**, **Technical** and **Ethical Advisory Committee** of independent experts.

The **Director General** will report to the Assembly of Members on the strategic, scientific, legal, financial and operational aspects of JERICO-RI. The Director General will be supported in these activities by the JERICO-RI **Central Management Office** which performs the administrative functions of JERICO-RI (legal advice, financial accounting, HR services, etc.).

The **Executive Committee** will be responsible for the operation and management of JERICO-RI and report to the Director General. The Executive Committee will also be supported by the Central Management Office.

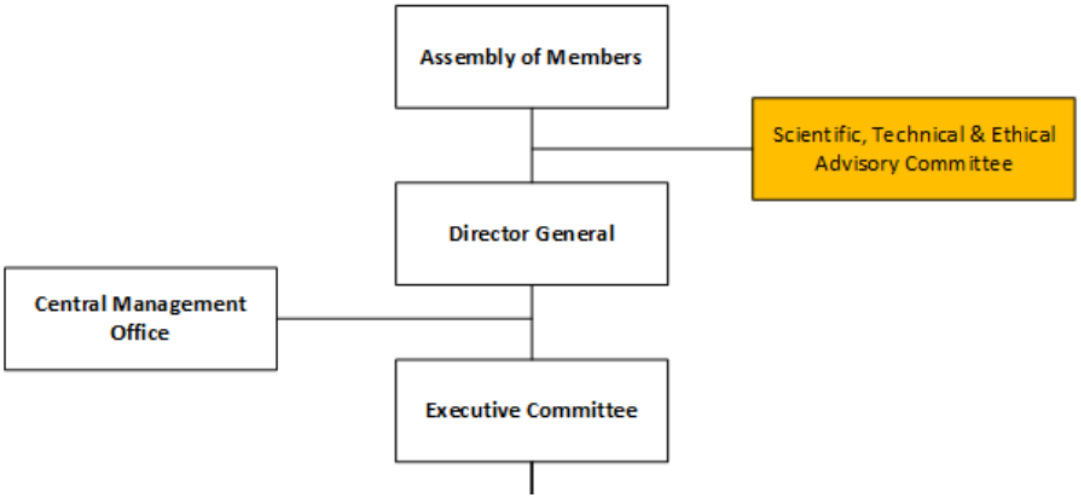

Figure 2: Governance, management and executive parts of JERICO-RI.

The operations and management of JERICO-RI that the Executive Committee is responsible for are done through the **Offices** providing the JERICO-RI Services. The Executive Committee has the power to establish or discontinue an Office subject to the agreement of the Assembly of Members. The Executive Committee will be composed of one "Head of Country" delegate appointed by each Member State, and one delegate elected from each Office.

Each Office will consist of one or more **Expert Centers**. Each Office has the power to establish or discontinue an **Expert Center** under its control, subject to the agreement of the Executive Committee. Each Office will elect one delegate to the

Executive Committee from amongst its membership to represent the Office's interests.

Each Expert Center will provide one or more **Services**. Each Expert Center has the power to establish or discontinue a Service subject to the agreement of the relevant Office.

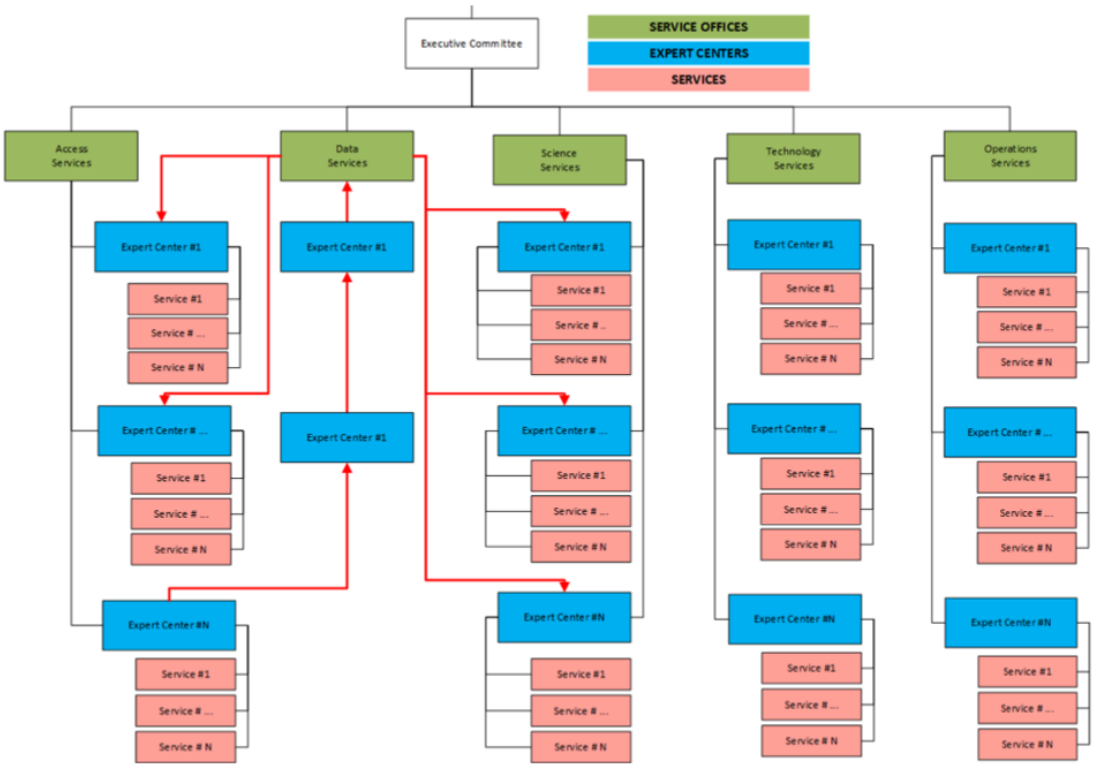

Figure 3: Services Offices, Expert centres and Services rendered by JERICO-RI.

Ultimately JERICO-RI will be governed at the highest level by the **Member States** that have joined the JERICO-RI. The governance system that each Member State adopts internally is a matter for each individual Member State, allowing for the regional specificities of JERICO-RI.

b. The coastal observatory network

The Technical Design for an Operational JERICO-RI (physical part of the RI) is described in detail in the Deliverable D2.1 of the JERICO-DS project. Succinctly, it describes a technological development roadmap to be implemented, tailored to the specificities of coastal sea observations. The foreseen RI will consist of multidisciplinary observing platforms, that are summarised in Table 1.

Table 1. Coastal ocean observing platforms that are envisioned to be part of the JERICO-RI (see detailed description in Deliverable D2.1. of the JERICO-DS project).

Future JERICO-RI infrastructure	BE	HR	EE	FI	FR	DE	EL	IE	IT	NL	NO	PT	ES	SE	Tot
Fixed plattform (moorings or buoys)	■	■		■	■		■		■	■			■	■	9
FerryBox systems			■	■	■		■			■		■			6
HF radars					■		■	■	■	■	■		■		7
Drifters (surface/profile)									■						1
Profilers (cable/buoy-based)														■	1
Gliders					■		■		■						3
ROV/AUV					■		■			■		■			4
Drones (various types)				■	■						■	■			4
Research vessel/manual sampling		■			■	■	■			■			■		6
Tide gauge networks				■	■		■				■		■		5
Wave buoy network					■			■	■						3
Weather buoy network			■		■			■							3
Benthic landers				■											1
Calibration and test facilities.					■		■								2
New instruments/methods															
Coastal/beach erosion	■				■		■								3
River buoys				■											1
Reflectance measurements				■			■			■					2
Mapping of noise and seabed				■	■		■			■					3
eDNA				■	■		■			■					3
Contaminants					■		■								2
Aquaculture and fisheries	■				■		■								4

The aim for JERICO-RI is to include in the future platforms innovative sampling tools, such as ROV/AUVs, drones (of various types), gliders and drifters/profilers. The tide gauge network is also a candidate for inclusion in the JERICO-RI platform catalogue.

The multi-platform approach recognises that different observational methodologies can provide different types of data and insights. Combining them to create a more comprehensive understanding of the coastal environment is paramount. With JERICO-RI, we enable a unique opportunity to provide holistic knowledge to the stakeholders that can help to address the complex and interconnected challenges facing coastal ecosystems and communities. By combining data from multiple observational methodologies and technologies, researchers and stakeholders will develop more comprehensive and integrated solutions to issues such as climate change, ocean acidification, and marine biodiversity loss. JERICO-RI aims to generate long (semi-) continuous time series that serve three purposes:

- To provide high resolution data for research on processes acting at several time scales, ranging from very small (seconds) to multiple years,
- To detect long-term trends and,

- To provide (near) real-time data for various users and to allow detection and responses to extreme events.

This means that observations should be continued in the same way for several years in the same locations or trajectories to allow for the detection of long-term trends and for the analysis of interannual variability. JERICO-RI observations will allow for the upscaled analysis of coastal processes, at a European scale.

A network of JERICO-RI Supersites, Advanced sites and Standard sites, with clearly different levels of observation capacities and requirements for coordination, will provide a framework on how to structure the regional observations and how to connect observing communities.

The national JERICO-RI infrastructures currently comprise various sensor-equipped observing platforms (see examples below), and many nations employ several types of platforms that support national coastal ocean observing efforts. The current JERICO-RI technological landscape is highly complex, with a large variation in types of observing platforms (with varying technological requirements), the extent of national observing capabilities and national infrastructure organisation (number/types of national partners).

The most widespread current national JERICO-RI catalogue included:

- Fixed platforms (platforms or buoys) - 13 countries
- HF radars - 6 countries
- Gliders - 6 countries
- FerryBox systems -6 countries
- Research vessels/manual sampling - 6 countries
- Tide gauge networks - 6 countries

Other platforms are listed by country as part of the current JERICO-RI catalogue included: drifters (surface/profile), profilers (cable/buoy-based), various autonomous observation systems (ROV, AUV, drones), tide gauge networks, wave buoy network, weather buoy network, benthic landers, in addition to calibration and test facilities. Several nations also list more traditional manual sampling on research vessels or other ships as part of the JERICO-RI catalogue.

c. The virtual hub, JERICO-CORE

JERICO-CORE is envisioned (JERICO consortium, 2022) as the unified central hub of JERICO to discover, access, manage and interact with JERICO resources

including services, datasets, software, best practices, manuals, publications, organisations, projects, observatories, equipment, data servers, e-libraries, support, training, and similar assets. More precisely JERICO-CORE aims at improving coastal data and information FAIRness [see https://www.go-fair.org/fair-principles/] by facilitating the development of services to support specialised thematic research activities and building synergies for coastal ocean resources and services, between JERICO and other international environmental Research Infrastructures. As a one-stop-shop service, JERICO-CORE will provide JERICO users an optimal, integrated form of access to:

- the JERICO physical infrastructures (platforms and sensors) offered by the JERICO technical expertise centres;
- Resources required to both harmonise and implement JERICO data lifecycle management methodologies: Best Practices, tools and services, and e-training modules;
- Quality controlled data that is routinely acquired by the different national coastal observatories, following the FAIR principles;
- Added-value products and services (indicators, nowcasts, analysis, etc.) generated by each individual JERICO thematic expertise centre;
- Dedicated cloud computing resources (hardware and software) allowing researchers to perform advanced analysis on multi-disciplinary, multi-scale, multi-domain and multi-sensor data sets.

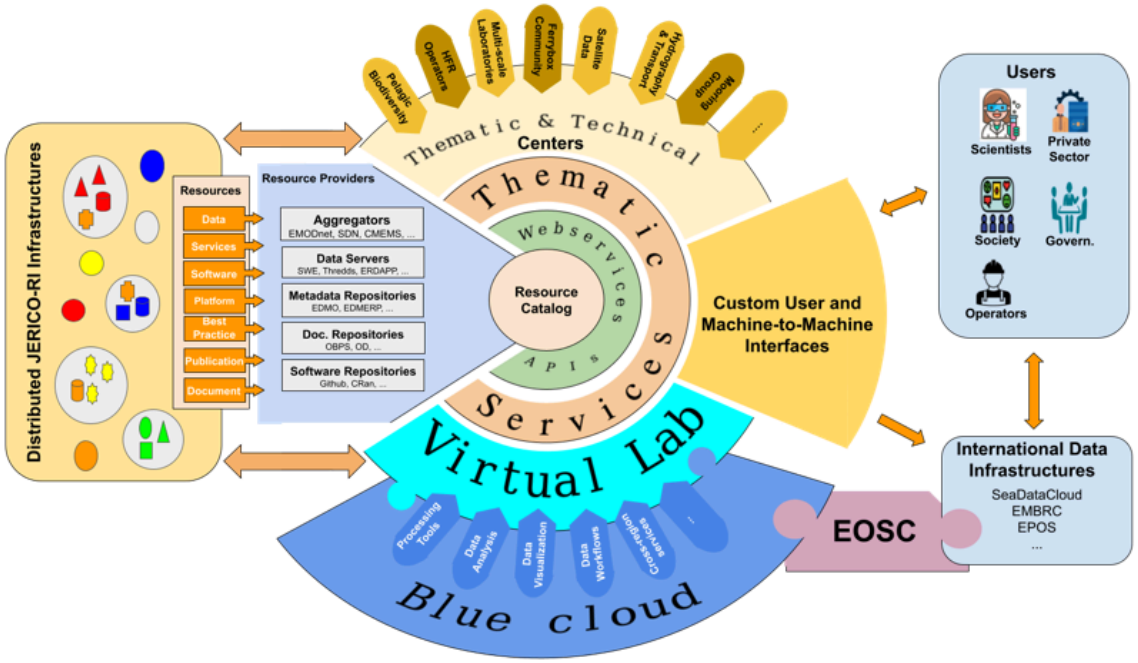

Figure 4: The JERICO-CORE concept is a highly distributed virtual infrastructure.

The JERICO-CORE is therefore a highly distributed, complex virtual infrastructure that will support most of the services delivered by JERICO-RI.

d. Physical access to the JERICO-RI

Physical access to facilities and sensors refers to the ability to physically visit and interact with equipment, instruments, or facilities that collect data through various sensors or other means. This is important for researchers who need to perform calibration, maintenance, or repairs on equipment, or who need to collect data that cannot be accessed or transmitted remotely.

Physical access to facilities and sensors can be challenging and expensive, especially if the equipment is located in remote or hazardous areas. This can require extensive planning, transportation logistics, and safety protocols.

Some facilities and sensors may have restricted access due to security or safety concerns, requiring researchers to obtain special permissions or clearances before being granted access. To facilitate physical access to facilities and sensors, some organisations and institutions provide researchers with specialised training or certification, such as safety training or specialised equipment handling training. In some cases, researchers may also be required to provide proof of liability insurance before being granted access.

Despite the challenges associated with physical access to facilities and sensors, it remains a critical aspect of scientific research, as it allows researchers to collect high-quality data and ensure the accuracy and reliability of their results. JERICO-RI will facilitate such access issues, by streamlining security training and certifications.

e. Virtual access to JERICO-RI Services and Products

Virtual access to observational products refers to the ability to access and analyse data collected through observational methods using virtual means, such as online databases or software tools. Observational products can include a wide range of information, such as climate data, satellite imagery, biological observations, and social science research data.

Virtual access to observational products is important for researchers, as it allows them to easily access and analyse data without having to physically travel to the location where it was collected. This saves time and resources, and also makes it easier for researchers from different parts of the world to collaborate and share data.

Many organisations and institutions offer virtual access to observational products, including government agencies, research institutes, and universities. Some examples of virtual data repositories and portals include the National Oceanic and

Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) data portal, the European Space Agency's (ESA) Earth Observation Data Centre, and the Global Biodiversity Information Facility (GBIF) data portal.

In addition to virtual access to data, there are also software tools and platforms that allow researchers to analyse and visualise observational products. Some examples of these tools include Google Earth Engine, which provides access to satellite imagery and other geospatial data, and RStudio, a programming language and environment useful for statistical computing and graphics.

4. Conclusion and next steps

The conceptual architecture of the future JERICO-RI has been described in detail, including the relationships between the foreseen components of the infrastructure. In summary, JERICO-RI will be a distributed system that consists of (a) the coastal observatories in Europe (Figure 5), that provides access and knowledge from observations, (b) the JERICO-CORE virtual infrastructure that provides virtual access to all measured data, products, and services of the JERICO-RI catalogue.

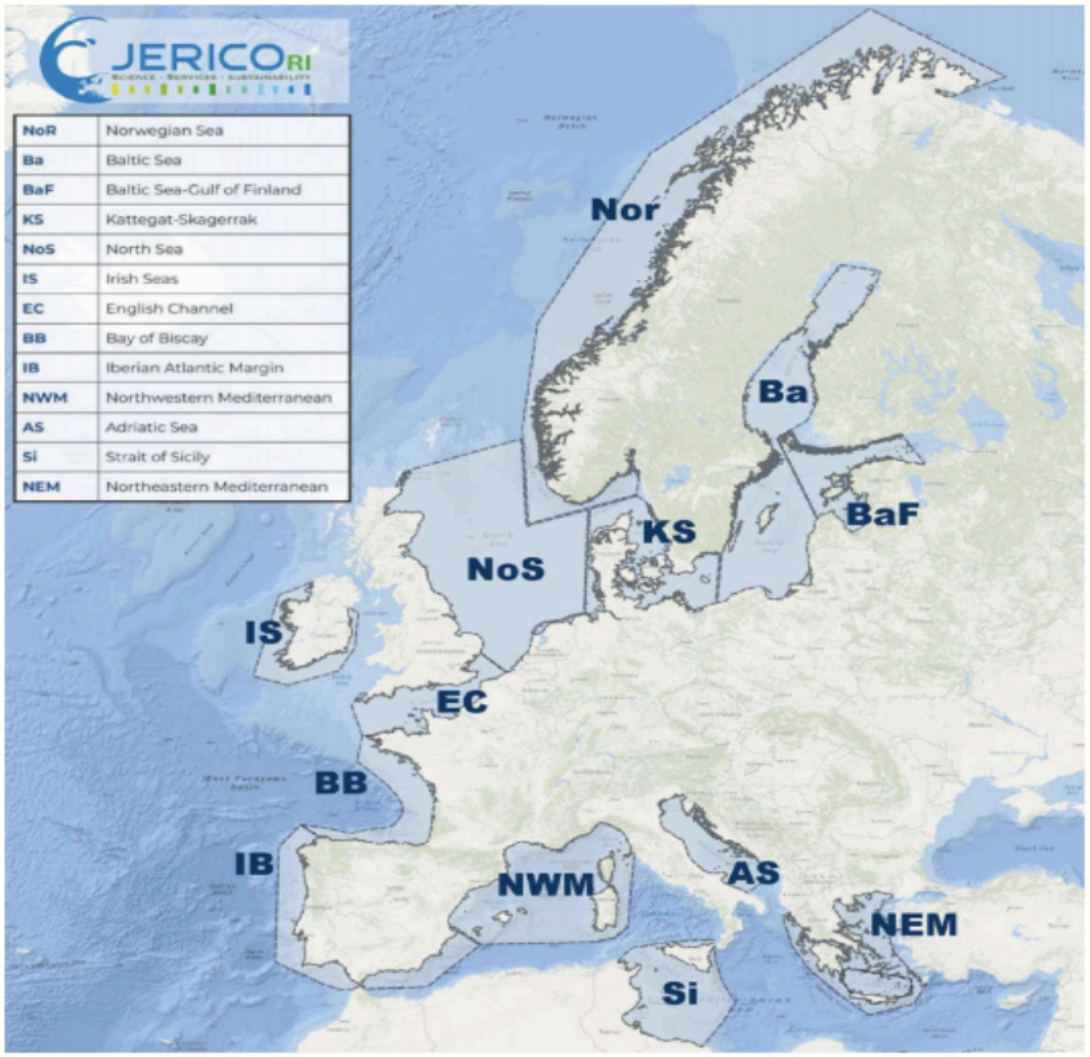

Figure 5: Marine coastal observatories, facilities, expertise and data for Europe

An overview of the different components of the complex JERICO-RI landscape is given in Figure 6, showing the multi-platform approach and the different Services to be provided. The envisioned governance will allow for a seamless exchange between the central office and the different components. Most importantly, it will take into account regional specificities, with the Assembly of Members holding the highest decision-making power in the governance.

Figure 6: Components of JERICO-RI

As of the writing of the deliverable, several gaps have been identified that will be filled by the end of the JERICO-DS project:

- A detailed description of current and planned Services and Products
- A detailed description of the links that will define the relationships between the future components of the RI (through the writing of Service Level Agreements)
- A detailed description of the links that will define the relationships between JERICO-RI and other RIs
- An extended and complete glossary
- A detailed description of foreseen Human Resources