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June 2024

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Image By Athena

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Dear Readers,

As the AquaINFRA project moves into its second year, we take the opportunity in this first newsletter to introduce the main aims and objectives and review the progress during the first year.

AquaINFRA is a pioneering project at the forefront of aquatic open science, funded through the European Open Science Cloud (EOSC) initiative. With a strategic investment of €16 million, AquaINFRA and its sister project Blue-Cloud 2026 play a pivotal role in advancing research within the marine and freshwater domains of the European Open Science Cloud (EOSC).

AquaINFRA's significance lies in its ability to address the pressing need for collaboration across marine and freshwater domains. By facilitating cross-disciplinary data sharing and analysis, AquaINFRA is directly contributing to the EU's mission to "Restore our Ocean and Waters" by 2030. Furthermore, it advances the European Open Science Cloud (EOSC) by developing a comprehensive research infrastructure tailored to the needs of aquatic scientists.

Photo By Linus Nylund

At its core, AquaINFRA is dedicated to enhancing collaboration, accessibility, and interoperability within the aquatic research community. By leveraging EOSC's robust infrastructure and services, AquaINFRA aims to connect researchers globally, providing access to diverse resources and ensuring seamless data exchange. Through initiatives like AquaINFRA, we are not only promoting open access to water-related data but also addressing critical challenges in water resource management and conservation.

The specific needs and challenges the project aims to address include data fragmentation, a lack of data interoperability, a lack of efficient tools for data collection, analysis, and visualisation, and collaboration barriers posed by a lack of availability of platforms that facilitate interdisciplinary cooperation among stakeholders.

AquaINFRA will address these needs and challenges through its main objectives, which include:

- **Accessible and Harmonised Data:** To ensure seamless access to comprehensive freshwater and ocean data, covering environmental and socio-economic aspects.

- **Development of Online Research Environments:** To facilitate advanced online research environments for efficient task-based data and analysis services.

- **Breaking Data Silos:** To dismantle national and thematic data silos, advocating a unified approach to aquatic data handling and analysis.

- **Development of Case Studies:** To implement practical case studies showcasing the project's impact on water quality, ecosystem restoration, and biodiversity conservation.

- **Capacity Building:** To cultivate open and reproducible scientific practices, uniting experts in freshwater and marine sciences, socio-economic studies, data science, and policy analysis.

- **Policy and Decision-Making Support:** To provide policymakers with science-based tools for effective environmental management and policy formulation.

- **Data Integration with EOSC Services:** To seamlessly integrate AquaINFRA with the European Open Science Cloud (EOSC), enhancing data sharing and collaboration.

- **EOSC Utilisation Enhancement:** To improve EOSC functionality, making it a more effective tool for integrative aquatic research.

To meet its objectives, AquaINFRA is co-designing and developing EOSC-compliant services that allow AquaINFRA users to seamlessly and easily find and access harmonised data from the diverse set of Pan-European and national metadata catalogues and existing data infrastructures, which host marine and freshwater data, as well as associated biodiversity data.

The services will comprise 4 modules: The AquaINFRA Interaction Platform (AIP), AquaINFRA Data Discovery and Access Service (DDAS), and the Virtual Research Environment (VRE), which are supported by an interactive visualisation. The modules together enable unified data access, fostering collaboration and contributing to AquaINFRA's broader aim of enabling transformative Open Science.

Practical case studies demonstrate real-world applications and the impact of the AquaINFRA services. These case studies will validate AquaINFRA's impact on water quality improvement, ecosystem restoration, and biodiversity conservation. They will provide valuable insights into AquaINFRA's effectiveness and adaptability in different aquatic environments, benefiting researchers, the AquaINFRA development team, and policymakers.

AquaINFRA's holistic approach to advancing aquatic research, coupled with its integration with EOSC and commitment to open science principles, positions it as a key driver of innovation and collaboration within the marine and freshwater domains. By addressing fragmentation, enhancing collaboration, empowering data-driven decision-making, and fostering innovation, AquaINFRA will contribute significantly to advancing aquatic research and supporting sustainable management of aquatic ecosystems.

In this newsletter, we take a closer look at the AquaINFRA Services, integration with EOSC, Case Studies and the projects' role in the wider EU landscape and Mission Ocean.

We hope you enjoy reading this newsletter.

The Coordination Team

AquaINFRA Online Research Environments
Empowering Collaboration and Data Access

AquaINFRA is committed to ensuring seamless access to comprehensive freshwater and ocean data through its cutting-edge online research environments. These environments, consisting of the AquaINFRA Interaction Platform (AIP), Data Discovery and Access Service (DDAS), and the Virtual Research Environment (VRE) play a crucial role in promoting collaboration among researchers and breaking down data silos across marine and freshwater domains.

The AIP serves as the central gateway, linking aquatic scientific communities with EOSC and AquaINFRA resources. AquaINFRA's DDAS connects diverse marine and freshwater data resources and enables seamless search, access, and harmonisation of FAIR data from various sources, enabling researchers to discover cross-domain data and products within the field of aquatic sciences. The VRE offers notebook services, models, and a training platform. These services are supported by interactive visualisation tools. The modules together enable unified data access, fostering collaboration and contributing to AquaINFRA's broader aim of enabling transformative Open Science.

Key Features and Functionalities

AquaINFRA Interaction Platform (AIP): Serving as the central gateway, the AIP links aquatic scientific communities with EOSC and AquaINFRA resources. It provides a user-friendly interface for researchers to access a diverse set of Pan-European and national metadata catalogues, as well as existing data infrastructures hosting marine and freshwater data.

Data Discovery and Access Service (DDAS): The DDAS connects diverse marine and freshwater data resources, enabling seamless search, access, and harmonisation of FAIR data from various sources. Researchers can discover cross-domain data and products within the field of aquatic sciences, fostering collaboration and facilitating transformative Open Science.
Virtual Research Environment (VRE): Offering notebook services, models, and a training

platform, the VRE empowers researchers with advanced tools for conducting comprehensive analyses. It addresses current challenges in aquatic research by providing efficient task-based data and analysis services, streamlining research processes, and fostering collaboration among researchers from marine and freshwater disciplines.

Photo By Janis Smits

Addressing Current Challenges: AquaINFRA's online research environments tackle prevalent challenges in aquatic research, including fragmented and outdated data, and a lack of easy-to-use tools for data integration and analysis. By providing advanced task-based services, user-friendly interfaces, and seamless data integration, AquaINFRA enables researchers to overcome these challenges and focus on their research tasks effectively.

Contributing to Transformative Open Science: The AquaINFRA Interaction Platform (AIP), Virtual Research Environment (VRE), and Data Discovery and Access Service (DDAS) not only facilitate unified data access but also foster collaboration among researchers, contributing to AquaINFRA's broader aim of enabling transformative Open Science. By breaking down silos and streamlining research processes, AquaINFRA's online research environments pave the way for impactful scientific discoveries and advancements in aquatic sciences.

Integration with the European Open Science Cloud (EOSC)

The European Open Science Cloud (EOSC) stands as a beacon of collaborative innovation, aiming to bolster open science initiatives and research capabilities throughout Europe. By fostering collaboration, facilitating seamless data access, and promoting the FAIR principles for data (Findable, Accessible, Interoperable, and Reusable), EOSC paves the way for transformative advancements in scientific research.

The implementation of EOSC, anticipated until 2028, unfolds through European Commission-funded projects, EOSC procurements, and in-kind contributions from stakeholders associated with the EOSC Association and Steering Board. The EOSC Strategic Research and Innovation Agenda (SRIA) outlines the framework guiding future research, development, and innovation endeavours within the EOSC ecosystem. Comprising 14 action areas, the SRIA sets the stage for the continuous evolution of EOSC.

AquaINFRA, among other initiatives, stands as a recipient of European Commission funding through EOSC. By harnessing the EOSC infrastructure and services, AquaINFRA enriches collaboration, bolsters access to diverse resources, enhances interoperability, and gains global visibility.
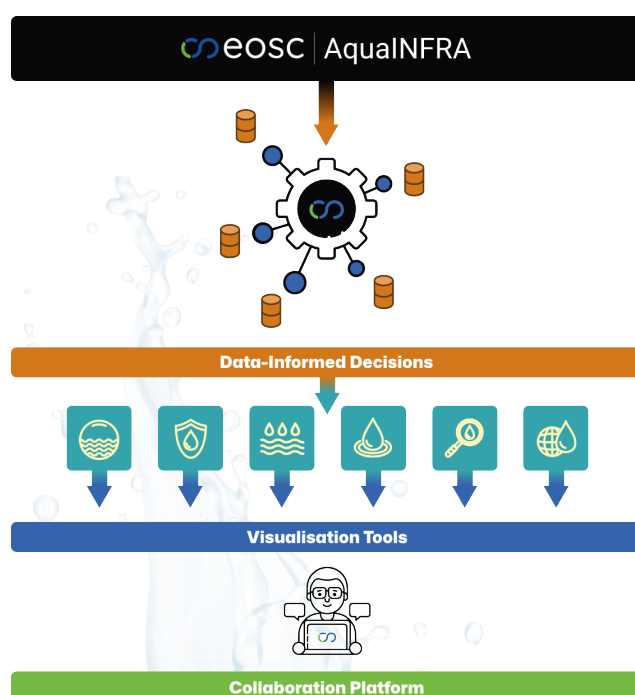
Key Integration Features:

- **Data Interoperability:** AquaINFRA embraces EOSC standards, facilitating the smooth exchange and integration of water-related data across varied platforms and research domains.

- **Resource Discovery:** Leveraging the EOSC metadata catalogue and discovery services streamlines the exploration and access of water-related datasets, tools, and services within the AquaINFRA ecosystem.

- **Collaborative Environment:** AquaINFRA harnesses the collaborative tools of EOSC, fostering interdisciplinary interactions among water scientists, policymakers, and stakeholders, thus driving innovation and problem-solving.

Benefits of Integration:

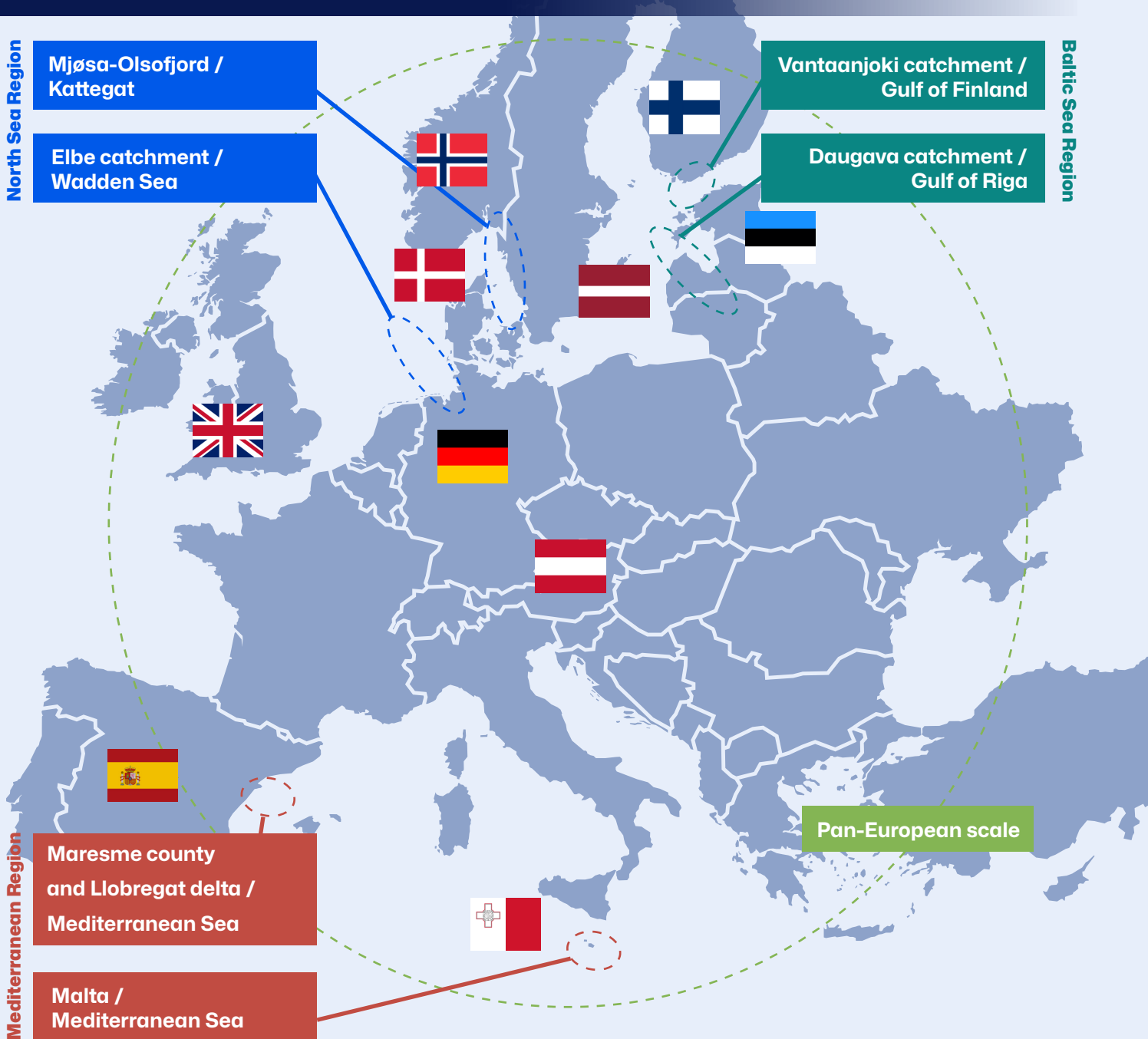- **Enhanced Collaboration:** AquaINFRA fosters global connections among aquatic researchers, catalysing collective efforts toward tackling pressing water-related challenges. Integration with EOSC nurtures collaborative partnerships, facilitating knowledge exchange and innovation to address complex water challenges effectively.

- **Access to Diverse Resources:** Leveraging the EOSC datasets, tools, and services broadens AquaINFRA's access to a rich array of resources, empowering researchers with comprehensive capabilities.

- **Interoperability:** Adhering to EOSC standards ensures seamless data exchange and integration across disparate platforms and disciplines, promoting harmonious collaboration and data utilisation.

- **Global Visibility:** AquaINFRA's integration with EOSC elevates its presence on the international stage, positioning it as a pivotal player in advancing aquatic open science.

- **Data FAIRness:** Prioritising the FAIR principles—Findability, Accessibility, Interoperability, and Reusability—ensures that AquaINFRA's data remains accessible, usable, and impactful across diverse research endeavours.

- **Enhanced Accessibility:** Users seamlessly discover, access, and reuse water-related data and resources through the unified EOSC-AquaINFRA platform, promoting efficiency and knowledge dissemination.

- **Scalability:** By leveraging EOSC infrastructure, AquaINFRA ensures scalability and sustainability, accommodating evolving data volumes and user demands over time, thus future-proofing its impact and reach.

AquaINFRA Case Studies
Bridging Marine and Freshwater Data

Mjøsa-Olsofjord / Kattegat

Elbe catchment / Wadden Sea

Vantaanjoki catchment / Gulf of Finland

Daugava catchment / Gulf of Riga

Baltic Sea Region

Pan-European scale

Mediterranean Region

Maresme county and Llobregat delta / Mediterranean Sea

Malta / Mediterranean Sea

The AquaINFRA project is dedicated to addressing the fragmentation and challenges associated with marine and freshwater environmental and socio-economic data by promoting Open Science principles, ensuring the publication of Findable, Accessible, Interoperable, and Reusable (FAIR) data and tools. Through a comprehensive framework and the implementation of the AquaINFRA Interaction Platform (AIP) and Data Discovery and Access Service (DDAS), AquaINFRA facilitates collaboration, knowledge sharing, and improved data accessibility for researchers, institutions, policymakers, and other users.

AquaINFRA focuses on four distinct case study regions, each representing unique challenges across the land-sea continuum:

Baltic Sea region: Addresses the need for data, tools and collaboration to tackle nutrient pollution and eutrophication in the Baltic Sea. AquaINFRA aims to assess changes in the environmental conditions of marine and river waters, land use and the environmental effectiveness and costs of measures aimed at reducing the nutrient load from land to the Baltic Sea. Pilot sites include the Gulf of Riga, the Daugava River catchment area, and small rivers of Southern Finland.

North Sea region: Focusing on climate monitoring, aquatic carbon cycling, and ecological indicators, AquaINFRA aims to develop satellite remote sensing methods to measure phytoplankton biomass. Pilot sites include the German Bight and Oslofjord coastal areas.

Mediterranean Sea region: Tackling challenges such as pollution, habitat destruction, and climate change impacts, AquaINFRA aims to protect water resources and ecosystems. Pilot sites include the Llobregat delta, Tordera River, Maresme county in Spain, and the Maltese islands.

Pan-Europe: Striving for better ecological conditions and biodiversity across Europe, AquaINFRA aims to integrate pan-European hydrography and connectivity information with freshwater biodiversity data. This case study acts as a single pilot site and serves as a blueprint for implementing policies relevant to aquatic ecosystems.

Photo By Joel Vodell

Pilot studies within each case study region will provide a blueprint for scientists and researchers to set up their workflows according to Open Science and FAIR data standards, to foster collaboration and standardisation in research.

The first step in this endeavour involves identifying potential data owners and providers and launching a dialogue to determine content, technical parameters, and accessibility of the required data. Stakeholder mapping exercises have revealed different primary users, including universities, research institutes, and policymakers, as well as groups of general users that will indirectly benefit from AquaINFRA services. This highlights the diverse range of organisations interested in utilising the AquaINFRA Data and Analysis System (DDAS) and AquaINFRA Interaction Platform (AIP) and underscores the importance of developing services and products to support research and decision-making processes.

Research Impacts

The case studies conducted under AquaINFRA aim to give significant insights and impacts, including:

- **Enhanced Understanding:** By investigating land-sea interactions and the impacts of human activities and climate change, AquaINFRA contributes to a deeper understanding of ecosystem dynamics.

- **Environmental Effectiveness:** Assessing the effectiveness of mitigation measures for reducing nutrient and carbon loads from land to sea aids in informed decision-making for ecosystem-based management.

- **Socioeconomic Evaluation:** Utilising socioeconomic data helps evaluate the implementation of mitigation measures and generate new knowledge using advanced frameworks.

- **Impact Assessment:** Assessing the impacts of human activities on ocean biomass, water quality and the carbon cycle provides valuable insights into ecosystem health and resilience.

These case studies serve as a foundational framework for AquaINFRA's development, guiding the project's direction and outcomes. Moving forward, collaborative efforts will continue to prioritise user stories and develop specific use cases to ensure the effectiveness of AquaINFRA's tools and services for ecosystem research and management.

Case Study Region 1
AquaINFRA Project Advances Data Accessibility for Source-to-Sea Analysis in the Baltic Sea Region

Sustainable land use practices and pollution reduction measures are being implemented across the Baltic Sea region to improve water quality. Data on the aquatic ecosystem state and the environmental and socioeconomic effects of measures to reduce nutrient concentrations in the aquatic environments in the Baltic Sea region are crucial for source-to-sea analysis yet often challenging to access. To address this gap, the AquaINFRA project is dedicated to illustrating how data accessibility challenges can be overcome data and making workflows for combining different data sources accessible through the AquaINFRA Data Delivery and Analysis System (DDAS) and the AquaINFRA Interaction Platform (AIP), in line with FAIR data guiding principles.

Two specific pilot sites within the Baltic Sea region exemplify these efforts: the Gulf of Riga and Daugava River Basin and the Small Rivers of Southern Finland and Vantaanjoki Catchment.

The freshwater flow of the Daugava River largely defines the state of the Gulf of Riga and is the main contributor of nutrients to the Gulf of Riga. Waters of the Gulf of Riga are becoming darker (browning) due to changes in the catchment area. This pilot study focuses on understanding the changes in water optical properties in the Gulf and the Daugava River, and the land-based processes that may be linked to these changes. In situ marine monitoring data is being made accessible and integrated with standard Case 2 Regional CoastColour (C2RCC) products in a workflow that will be accessible through DDAS and AIP.
In Southern Finland's small river basins, including the Vantaanjoki River basin, challenges remain in accessing high-frequency monitoring data and integrating them with remote sensing data. The AquaINFRA project aims to address this issue, demonstrating the creation of seamless water quality data from land to sea using high-frequency water quality monitoring with FerryBox observations and combining sensor data with satellite observations.
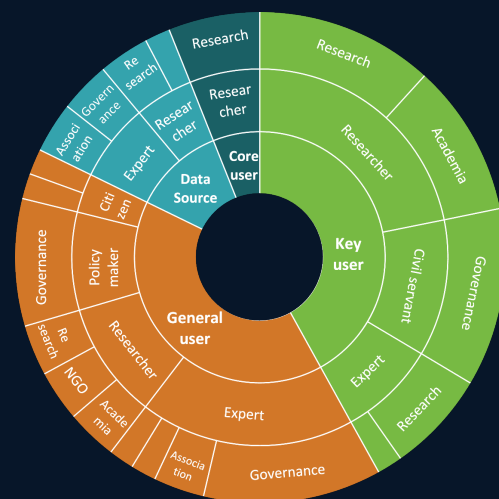
Identified AquaINFRA stakeholders and their distribution across different user groups in Baltic Sea case study region.

Collaboration with national authorities and research institutions is essential for improving accessibility to data and implementing measures to mitigate pollution and monitor measure effectiveness. Through these initiatives, the AquaINFRA project is shedding light on the effectiveness and interplay of various measures implemented under the management plan to mitigate pollution from various sources. Moreover, it highlights the importance of FAIR data for monitoring and improving the state of the Baltic Sea and rivers in the catchment area.

Case Study Region 2

AquaINFRA Project Integrates Satellite and In Situ Data to Enhance Water Quality Monitoring in the North Sea Region

The AquaINFRA project is advancing water quality monitoring efforts in the North Sea region by integrating various data formats from multiple sources to study land-sea interactions.

The use case aims to demonstrate how to overcome fragmentation in water quality monitoring along the aquatic continuum from lakes, and rivers to the sea by application of an optical water type-specific and neural network-based processing scheme for Copernicus satellite data. Different earth observation data will be combined with products from the Copernicus Marine, Land and Climate Change Services and complementary heterogeneous in situ data.

In the Elbe River Estuary and the Wadden Sea, innovative methods for determining water constituents using spectral reflectance have been developed. These methods, coupled with satellite data, enable the study of phytoplankton diversity and the measurement of dissolved and particulate organic carbon. However, challenges arise from turbid and optically complex waters, necessitating careful adjustments to regional algorithms for satellite data processing.

For the Oslofjord and Glomma Rivers, a complex fjord system in Southern Norway, the AquaINFRA project focuses on understanding the circulation dynamics and nutrient supply. Satellite data, combined with in situ measurements and river discharges, provide valuable insights into freshwater inflow impacts on ecosystem quality. The decline in long-range nutrient transport underscores the importance of local sources for ecosystem health in fjords and protected coasts.

Identified AquaINFRA stakeholders and their distribution across different user groups in North Sea case study region.

Through these initiatives, the AquaINFRA project aims to support interdisciplinary questions related to freshwater inflows, land-sea interactions, human impacts on ocean biomass, and the carbon cycle. By integrating satellite data products into AquaINFRA services the project contributes to a more holistic approach to environmental monitoring and assessment in the North Sea region. Improved satellite data and new approaches for estimating the carbon cycle will benefit researchers, policymakers, and environmental authorities alike.

Case Study Region 3
AquaINFRA Project Advances analysis of inland water quantity, quality and coastal ecological impacts in the Mediterranean Sea Region

The AquaINFRA project is making significant strides in advancing conservation efforts in the Mediterranean region through three main pilot sites: the Maltese islands, the Tordera River catchment and Maresme County, and the connected Llobregat delta. These sites serve as focal points for developing comprehensive models and strategies to address water quality, quantity, and ecological challenges.

In the Tordera River and Maresme County, efforts are underway to develop an integrated inland surface water model linked to a coastal model being developed for the Llobregat Delta. This approach aims to provide a holistic understanding of the entire water cycle, incorporating climate and socioeconomic variables. With the support of key stakeholders such as the University of Barcelona, the Autonomous University of Barcelona, and the Catalan Water Agency, the project seeks to analyse the impacts of urban expansion, reforestation, and tourism on freshwater resources and ecosystems.

In the Llobregat Delta, researchers are working to address the complex interplay between freshwater and saltwater dynamics. Current circulation models are too coarse for coastal-scale modelling. This pilot study aims to build a high-resolution circulation model that includes biogeochemical parameter estimation and considers land and river inputs. Ultimately, this model will help estimate threats and predict risks to the marine environment.

Through collaboration with stakeholders and improvement of accessibility to qualitative data, efforts are being made to refine coastal and inland-marine modelling approaches and support scenarios analysis for inland water quantity and coastal impacts jointly with the Tordera River pilot study.

Meanwhile, the Maltese islands present unique challenges due to low surface runoff, intense urbanisation pressures and climate change impacts which are exacerbating water scarcity and coastal vulnerabilities. AquaINFRA researchers at the University of Malta are working on an inland-marine 3D model to understand the quantity of nutrients and solutes discharged from land to the sea through groundwater and the impacts of anthropogenic factors on the water quality of Maltese bathing waters. The model will be used to study groundwater resources based on long-term climate projections and inform decision-making to reduce the risk of freshwater depletion.
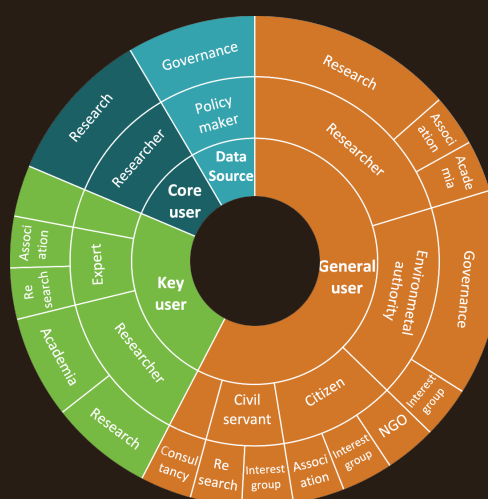
Identified AquaINFRA stakeholders and their distribution across different user groups in Mediterranean case study region.

By integrating satellite data, modelling techniques, and stakeholder engagement, the AquaINFRA project aims to provide valuable insights and tools for sustainable water resource management and conservation in the Mediterranean region.

Case Study Region 4
AquaINFRA Project Advances Understanding of Pan-European Freshwater Biodiversity Patterns

Serving as a single pilot site, the Pan-European region case study aims to establish workflows and analytical pathways using AquaINFRA services and integrated, openly available data sources available in the AquaINFRA Data Discovery and Access Service (DDAS) to examine species distribution and the drivers, and pressures affecting freshwater biodiversity.

With a focus on addressing the fragmentation in freshwater and marine science, as well as environmental policies, knowledge, data, and management, the Pan-European case study seeks to contribute to EU environmental policies in alignment with the EU Green Deal targets. By utilising publicly available datasets and modelling techniques, researchers aim to provide valuable insights into the restoration of healthy oceans and inland waters.

Through the integration of modelling techniques, openly available data, and stakeholder engagement, the AquaINFRA project is poised

to make significant contributions to biodiversity conservation efforts across the Pan-European region.

Identified AquaINFRA stakeholders and their distribution across different user groups in Mediterranean case study region.

As we reflect on the progress made during the first year of the AquaINFRA project, we are excited to share with you some key highlights and achievements that have propelled us closer to our mission of advancing aquatic open science.

Context and Overall Objectives: AquaINFRA's overarching objective is to develop an EOSC-compliant research infrastructure equipped with FAIR multi-disciplinary data and services to support marine and freshwater scientists and stakeholders in restoring healthy oceans, seas, and coastal and inland waters. Our efforts have been focused on addressing the need for seamless access to relevant data, breaking silos, and better utilising EOSC as an integrative research infrastructure.

Work Performed and Main Achievements: During the first year, significant progress has been made towards laying the foundation for AquaINFRA's architecture. A comprehensive report on the AquaINFRA Baseline Architecture was delivered, outlining the project's architectural approach and its alignment with EOSC initiatives. Additionally, the AquaINFRA Data Discovery and Access Service (DDAS) user requirements were identified, paving the way for the development of seamless access to hydrosphere data.

Case Study Regions and Use Cases

AquaINFRA's case study regions encompass vital freshwater and marine ecosystems, including the Baltic Sea, the North Sea, and the Mediterranean Sea. Deliverables have outlined the framework for integrating case studies into the project's development process, ensuring seamless interoperability with EOSC.

Results Beyond the State of the Art: AquaINFRA has successfully developed a prototype for the DDAS, functioning as a Minimum Viable Product (MVP). This prototype, along with advancements in the AquaINFRA Interaction Platform, propels us beyond the state of the art, enabling easier access to relevant data across the aquatic continuum.

Policy-Relevant Evidence: Our project underscores the critical need for easier and seamless access to relevant data to support healthy oceans, seas, and coastal, and inland waters. By addressing this need, AquaINFRA contributes valuable policy-relevant evidence to support informed decision-making and sustainable management of aquatic resources.

As we move forward into the next phase of the AquaINFRA project, we remain committed to advancing aquatic open science and fostering collaboration across disciplines and borders.

Photo By Matt Hardy

AquaINFRA and the EU Mission "Restore our Ocean and Waters" by 2030

Image By CraftyImago

In a significant move to safeguard the health of oceans, seas, coastal, and inland waters, the European Commission has allocated €16 million to AquaINFRA and its sister project, Blue-Cloud 2026. These projects will play a pivotal role in connecting data on the marine and coastal environment, biodiversity, and the water cycle with the overarching goals of the EU Mission "Restore our Ocean and Waters" by 2030.

Central to these initiatives is the integration of data-driven approaches with the 'Blue Economy', a critical component of sustainable development. By harnessing the power of data and fostering collaboration among diverse stakeholders, the Blue-Cloud 2026 and AquaINFRA projects aim to advance the understanding and management of aquatic ecosystems.

The European Open Science Cloud (EOSC) initiative, which seeks to enable Open Science practices across Europe, is providing funding for these projects. This investment underscores the Commission's commitment to promoting transparency, collaboration, and accessibility in scientific research.

Both the Blue-Cloud 2026 and AquaINFRA projects are designed to promote Open Science practices and implement FAIR (Findable, Accessible, Interoperable, Reusable) data commons and collaborative data services. Their overarching objective is to facilitate the sharing and reuse of publicly funded research findings and data among diverse stakeholders, including scientists, public authorities, citizens, and industry.

These projects will serve as integral components of the EOSC ecosystem, demonstrating the interplay between the EOSC data space and the Green Deal data space. By involving multiple research communities and data infrastructures in multi-disciplinary use cases, they will contribute to the development of the science base necessary for the Mission's 'Digital Ocean and Waters Knowledge System' and its 'Digital Twin' of the Ocean.

While the Blue-Cloud 2026 and AquaINFRA projects have distinct focuses, they are complementary. Together, they will support the uptake and continued development of the EOSC as a federated European infrastructure. The tools and services developed by these projects will be made available to other researchers through the EOSC portal and other relevant platforms, such as EMODnet.

Both projects kicked off in mid-February 2023 and will run until 2026. As they progress, they are expected to yield valuable insights, tools, and resources that will not only advance scientific understanding but also contribute to the sustainable management of oceans and waters for generations to come.

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