iAtlantic
INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

POLICY BRIEF

Building capacity for effective ocean management in the Atlantic region: Examples from iAtlantic

L. von Pogrell, B. Boteler & V. Gunn

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Key messages:

- The availability of accessible, user friendly and cost-effective deep-ocean technology that can be easily deployed and efficiently maintained is essential in supporting countries' contribution to global ocean sustainability goals.
- Co-designing research programmes and creating collaborative and supportive networks across the Atlantic region is critical to maximise the impact of scientific research, translate it into 'actionable knowledge' and shape ocean policy and governance regimes at ocean basin scale.
- Research expeditions are crucial for collecting deep-sea data but the high cost of seagoing research creates an imbalance in research opportunities, disadvantaging scientists based in countries without access to research vessels.
- Enabling researcher mobility supports the exchange of knowledge and skills between individuals and research groups, helps to build new and strengthen existing networks, facilitates collaboration and broadens the horizons of individual researchers.
- A standardised approach to deep-sea data collection and open-access storage in centralised long-term data repositories and catalogues is essential. User friendly and accessible platforms and tools that can be used by stakeholders from diverse backgrounds to share data and fulfil commitments to diverse policy initiatives are key.
- The communication gap between (ocean) researchers and decision-makers is a recognised challenge that can hinder progress in achieving sustainable ocean management. Improving scientists' understanding of policy needs and priorities, as well as policymakers' understanding of scientific challenges and limitations is crucial in addressing this lacuna.

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Front cover image: Fauna on the seafloor off Iceland, photographed by Solvin Zankl during the IceAGE3 (SO276) expedition with PI Dr. Saskia Brix in summer 2020.

The role of deep-sea science in ocean management

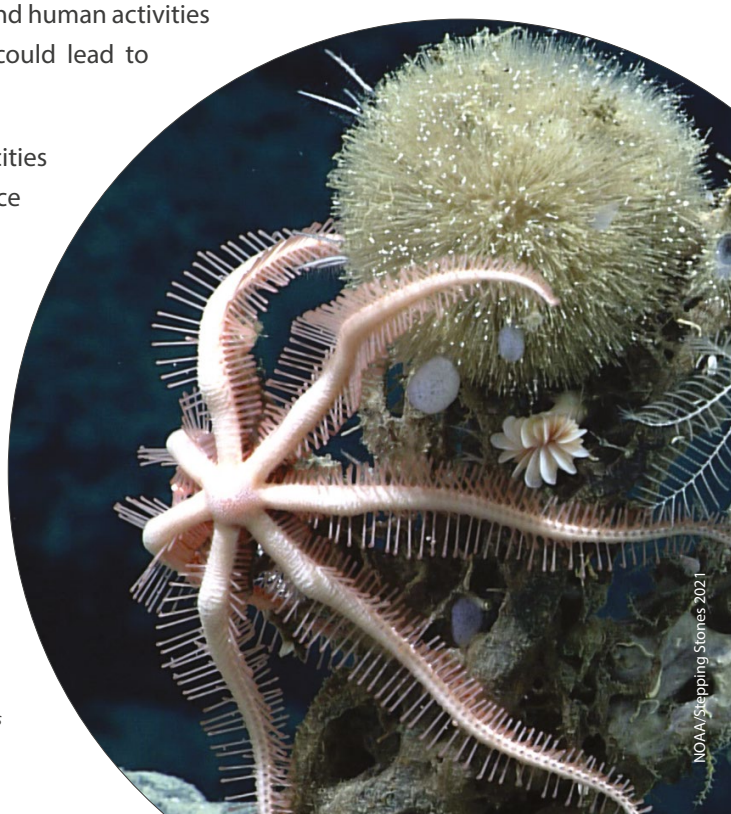
The vast and enigmatic depths of the Atlantic Ocean harbour a plethora of unique and fragile ecosystems that are still largely unexplored, despite their ecological and socioeconomic significance. These deep-sea ecosystems face mounting challenges from various anthropogenic pressures and the escalating impacts of climate change. As human activities continue to impact these delicate environments, there is an urgent need to expand human and technological capacities – particularly in the Global South – to provide the necessary scientific information* on which to base robust, fair decision making and effective governance for a changing ocean. Numerous international commitments and initiatives demonstrate a shared recognition of the critical role that advancing ocean-related scientific knowledge plays in sustainable governance of the ocean. These include:

- Sustainable Development Goal (SDG) 14 'Life Below Water'
- United Nations Decade of Ocean Science for Sustainable Development (UN Ocean Decade) Challenge 9 'Skills, knowledge and technology for all'
- Multiple targets of the Kunming-Montreal Global Biodiversity Framework (GBF), adopted under the United Nations Convention on Biological Diversity (CBD)
- The newly agreed instrument on conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (the BBNJ Agreement) established under the United Nations Convention on the Law of Sea (UNCLOS)
- United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement
- The European Union's commitment to being a global leader in tackling global climate and environmental challenges through its Green Deal, which recognises the need to expand capacity and enhance accessible and interoperable data to achieve this.

These individually and collectively emphasise the importance of advancing scientific knowledge, developing ocean research capacity and transferring marine technology to underpin effective sustainable management and conservation strategies in an effort to halt biodiversity loss and improve the state of the marine environment.

Recognising the critical need for a comprehensive understanding of deep-sea ecosystems and the impacts of human activities on them, the iAtlantic project emerged as an ambitious research initiative funded by the European Union's Horizon 2020 programme. iAtlantic seeks to address gaps in our understanding of deep-sea environments highlighting potential impacts of climate change and human activities at an ocean-basin scale, and identify the tipping points that could lead to irreversible changes in deep-sea and open ocean ecosystems[1].

This policy brief explores the human and technological capacities required to meet international and regional ocean governance commitments[2], focusing on the role of science. It uses selected examples from iAtlantic to demonstrate how scientific advances and inclusive approaches can help to address capacity gaps and support sustainable management of marine ecosystems in the Atlantic Ocean. These contributions include developing cost-effective data collection systems, co-designing research strategies, sharing expedition programmes, supporting professional mobility and standardising data management practices, as well as promoting information exchange and dialogue between scientists, policymakers and other stakeholders.



NOAA/Stepping Stones 2021

** We recognise that there are other types of information (indigenous, traditional knowledge) which methods and approaches and capacity are also needed, but are not the focus here as iAtlantic's work centred primarily on scientific data.*

iAtlantic is a multidisciplinary research programme seeking to assess the health of deep-sea and open-ocean ecosystems across the full span of the Atlantic Ocean. It aims to deliver knowledge that is critical for responsible and sustainable management of Atlantic Ocean resources in an era of unprecedented global change. iAtlantic is undertaking an ocean-wide approach to understanding the factors that control the distribution, stability, and vulnerability of deep-sea ecosystems. Work spans the full scale of the Atlantic basin, from the tip of Argentina in the south to Iceland in the north, and from the east coasts of USA and Brazil to the western margins of Europe and Africa. Central to the project's success is the international collaboration between researchers throughout the Atlantic region. The innately diverse and multidisciplinary nature of the iAtlantic project acted as a driver for collaboration on an international scale, fostering cultural exchange and facilitating interdisciplinary approaches to deep-sea exploration and research. For more details: www.iatlantic.eu

Expanding technological capacities

Effective management of deep-sea and open ocean ecosystems is underpinned by data from advanced ocean technologies. For developing countries, the availability of accessible, user friendly and cost-effective deep-ocean technology that can be easily deployed and efficiently maintained is essential in supporting their contribution to global ocean sustainability goals.

Deep-sea and open-ocean exploration and research have been revolutionised by advanced technologies, such as remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and cutting-edge imaging and sampling techniques. These tools enable scientists to explore previously inaccessible areas of the ocean and conduct detailed investigations of deep-sea habitats, geological structures and marine life. A deep-sea capacity assessment in 2022[3] revealed that whilst deep-sea scientific expertise exists in many developing countries, the lack of access to essential scientific infrastructure such as research vessels, deep submergence vehicles, sensors and data tools is a significant issue. Even where access to equipment exists, there is often limited technical capacity and/or lack of sustained research funding to operate and maintain the instruments needed to underpin locally led scientific initiatives such as marine ecosystem mapping, sampling and monitoring, and other research activities.

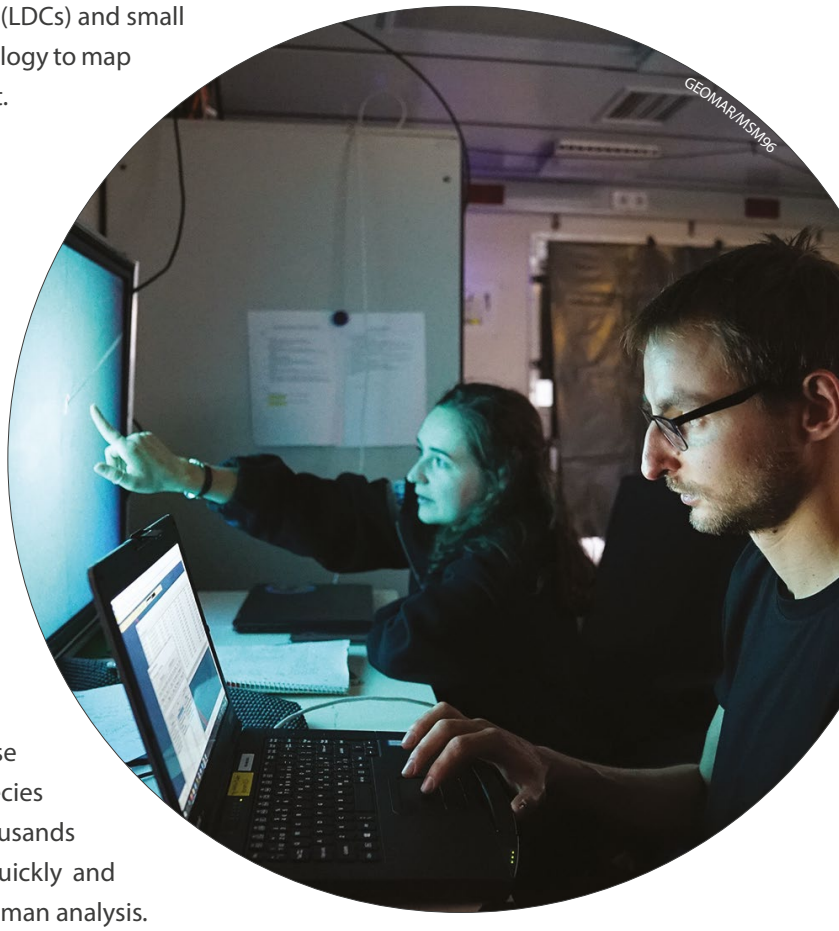
IMAR/UAzores

iAtlantic prioritised the advancement and sharing of innovative tools for deep-sea research, developing technologies and techniques that can help address these challenges. Some of these are highlighted below, exemplifying how technological innovation can enhance understanding of the ocean.

Improving access to survey technology

Addressing the primary obstacles to collecting deep-sea scientific information – the high cost and complexity of deep-sea technology and lack of access to ocean-going research vessels – iAtlantic supported the operational advancement of the Azor drift-cam (pictured left). This cost-effective video survey system enables rapid assessment of

deep-sea benthic habitats in water depths of up to 1000 metres, using vessels of opportunity such as fishing vessels. Data generated by the system can be used to analyse distribution patterns of deep-sea benthic biodiversity and help identify the main environmental drivers influencing these patterns, as well as ascertain new areas that meet the United Nations Food and Agricultural Organization's definition of vulnerable marine ecosystems (VMEs). A guide to constructing the drift-cam system using readily available and affordable components is available as an open-access paper[4], allowing research communities to build and maintain their own drift-cam systems. This is especially relevant for least developed countries (LDCs) and small island developing States (SIDS), who can use this technology to map biodiversity within their national waters at minimal cost.



Using artificial intelligence

Improving access to survey technology is just one step towards a better understanding of the deep-sea environment. Enhancing the way in which data can be processed and analysed offers potential to gain deeper understanding of ecological dynamics, drivers of change and ecosystem vulnerability to that change. Traditionally, classifying and analysing seafloor imagery (video or stills) is a labour-intensive process that requires advanced scientific expertise and potentially complex computational skills. To address this, iAtlantic worked to advance and improve automated image analysis using artificial intelligence (AI) and machine learning to identify seafloor objects from survey image data. These advances enable faster, automated recognition of species and substrate from survey imagery, meaning the thousands of images collected at sea can be processed more quickly and accurately by computer rather than relying solely on human analysis.

Improving our ability to predict biodiversity patterns

Increased availability of accurate biodiversity and habitat data (e.g., from seafloor imagery) aids the development and improvement of seafloor species and habitat distribution models – a prediction of where species and ecosystems are likely to be located in the ocean. This is a particularly important tool for the large parts of the ocean where observational data is sparse, but also to indicate where ecosystems might be particularly vulnerable to threats such as climate change or pollution.

iAtlantic invested significantly in better understanding and visualising the distribution patterns of habitats and species in the Atlantic basin. A plethora of observational data was processed using new imaging and analysis approaches for marine species detection and classification[5] and then combined with existing datasets to extend the overall mapping coverage of the Atlantic basin. Predictive habitat modelling techniques were applied to extrapolate species and biodiversity observations up to regional and global scales, generating new understanding of ecosystem distribution, status and resilience from local scale to full Atlantic scale.

Expanding human capacities

Enabling researcher mobility has been a pivotal aspect of the iAtlantic project[6]. By co-designing field campaign and sampling strategies, providing seagoing opportunities and facilitating researcher exchange between institutions, the project has sought to strengthen international collaboration and promote a global network of experts dedicated to understanding and protecting deep-sea ecosystems.

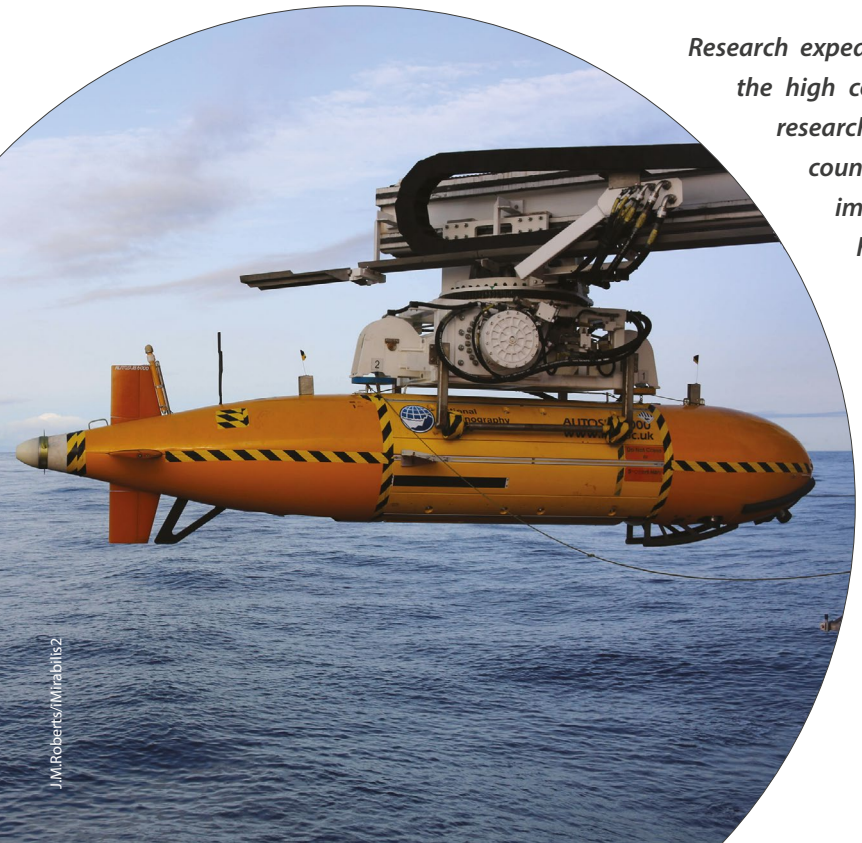
Co-designing field programmes and research strategies

Co-designing research programmes and creating collaborative and supportive networks across the Atlantic region is critical to maximise the impact of scientific research, translate it into actionable knowledge and shape ocean policy and governance regimes at ocean basin scale.

Co-designing field programmes and research strategies supports developing countries – their researchers, field crews and technical support – to be actively involved in the design of research activities from the outset. Co-design ensures that the needs (e.g., technology requirements) as well as specific research aims (e.g., area of study) of local researchers are not only included but prioritised in research activities, thereby fostering the long-term development of programmes. Ultimately, co-design improves the capacity of local research programmes but can also help improve research outputs, as research projects benefit from aligning with the expertise and experience of local researchers. Co-design can help to create a level playing field and transparent approach to multi-year research initiatives that often involve numerous participants and organisations from around the world.

iAtlantic was conceived, designed and planned as a fully collaborative North-South research initiative, set within the embrace of the Belém Statement[7] - a joint Declaration on Atlantic Ocean Research and Innovation Cooperation between the European Union, Brazil and South Africa. At an operational level, iAtlantic took a fully inclusive approach to its research: field programmes and experiments were co-designed and jointly executed by partners located in the North and South Atlantic regions, students were co-supervised across the Atlantic, and project activities planned as far as possible to accommodate different time zones, skill levels, technical capacities and national research priorities.

Seagoing opportunities for marine researchers



J.M.Roberts/Mirabilis2

Research expeditions are crucial for collecting deep-sea data but the high cost of seagoing research creates an imbalance in research opportunities, disadvantaging scientists based in countries without access to research vessels. This could be improved by creating funding streams and resources for hands-on training and remote learning, tailored to underrepresented groups.

Recognising these imbalances, iAtlantic actively sought seagoing opportunities for researchers in the South Atlantic, blending infrastructure and know-how from the North Atlantic with specialist expertise from the South. This approach facilitated knowledge exchange and skills transfer across the Atlantic, as well as reinforcing a robust, long-term, international collaborative network.

The iAtlantic field programme also sought to maximise seagoing opportunities for early career researchers (ECRs), providing hands-on experience in data and sample collection and reinforcing the collaborative and multidisciplinary nature of marine science, with ECRs working alongside scientists from different disciplines, institutions, countries and cultures.

A partnership with South Africa's SEAmester programme[8] – a unique shipboard programme led by University of Cape Town that integrates interdisciplinary coursework, hands-on ship-based experience and interaction between leading South African marine researchers – provided seagoing opportunities for 126 young South African students in 2019, 2022 and 2023.

However, berths on research vessels are limited. To optimise researcher engagement despite limited onboard opportunities and COVID-related travel restrictions, iAtlantic embraced innovative solutions, including the 'ship-to-shore buddies' scheme employed during the iMirabilis2 expedition in summer 2021. This initiative facilitated virtual participation for ECRs from Brazil, Cabo Verde, Colombia, Ghana, Portugal, South Africa and Togo, using a combination of social media and direct video conferencing: through a chat group and weekly calls, land-based ECRs received daily updates, training videos and opportunities to interact directly with the ECR 'buddies' on board the ship[9].

Other valuable opportunities to engage shoreside marine scientists in deep-sea exploration are provided by initiatives such as NOAA's Ocean Explorer programme[10], which streams live, high-quality video feed from its ROV cameras during dives. This initiative actively seeks and recruits real-time online engagement from deep-sea experts around the world to not only help identify the species seen in the deep, but also to help plan dive and sampling strategies. The data collected during their expeditions is made freely available for the wider scientific community to use.

Researcher mobility

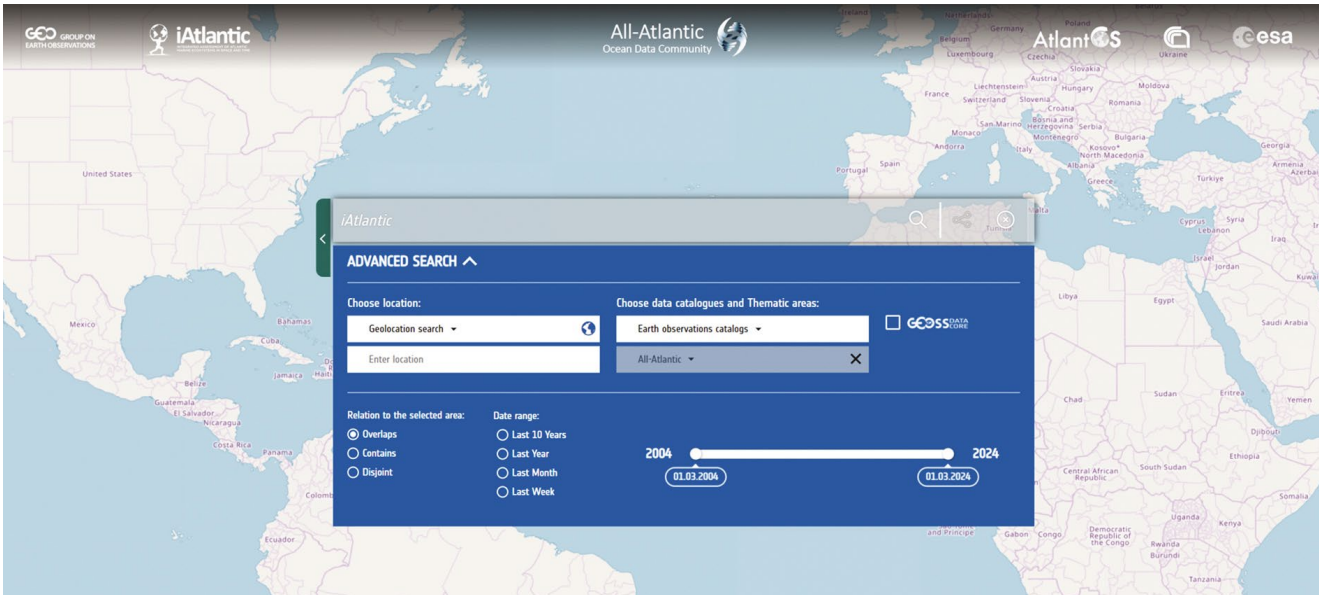
Enabling researcher mobility supports the exchange of knowledge and skills between individuals and research groups, helps to build new and strengthen existing networks, facilitates collaboration and broadens the horizons of individual researchers by exposing them to new avenues of investigation.

To address large-scale environmental issues, researcher collaboration and mobility are essential. As well as ensuring the circulation of skills and ideas around the world, researcher mobility underpins the application of collective expertise across multiple disciplines, generating innovation, lateral thinking and scientific advances – in addition to improving research efficiency through reduction of duplicated effort, improving access to and equitable use of large-scale scientific infrastructure and specialist facilities, strengthening professional networks and creating new opportunities for collaborative research. For individual researchers (of all levels), mobility offers opportunities to gain experience and new skills from different institutions, cultures and scientific fields, broadening their research horizons and essentially driving the evolution of science.

Large-scale, international, multidisciplinary research programmes – such as iAtlantic – offer an excellent framework in which to facilitate researcher mobility, provided it is adequately prioritised as part of the project's implementation and appropriate project resources are ringfenced to support it. Allocating sufficient funds from the outset to properly support researcher exchange between institutions and/or industry, travel to join expeditions, conferences and workshops, and to engage in stakeholder events that provide exposure to the world outside academia is an important step in project design but is commonly deprioritised or overlooked.

Partnering with schemes that are designed to provide mobility or capacity development support (for example EU COST Actions or Marie Curie funding streams) can be effective, but securing funds from such schemes is usually competitive and requires early and strategic planning to ensure success. iAtlantic took both approaches: capacity development (including researcher mobility) was identified as a priority at an early stage in the project's inception with funds set aside to support it. iAtlantic also worked closely with the Marine Animal Forests of the World COST Action[11] to secure funding to support researcher attendance (both from within and outside the project) at specific training events. A drawback of this initiative is that funding support was restricted to EU-based researchers, so careful allocation of funding from other sources was necessary to ensure inclusive participation across the project.

Edson Silva Delgado/GEOMAR

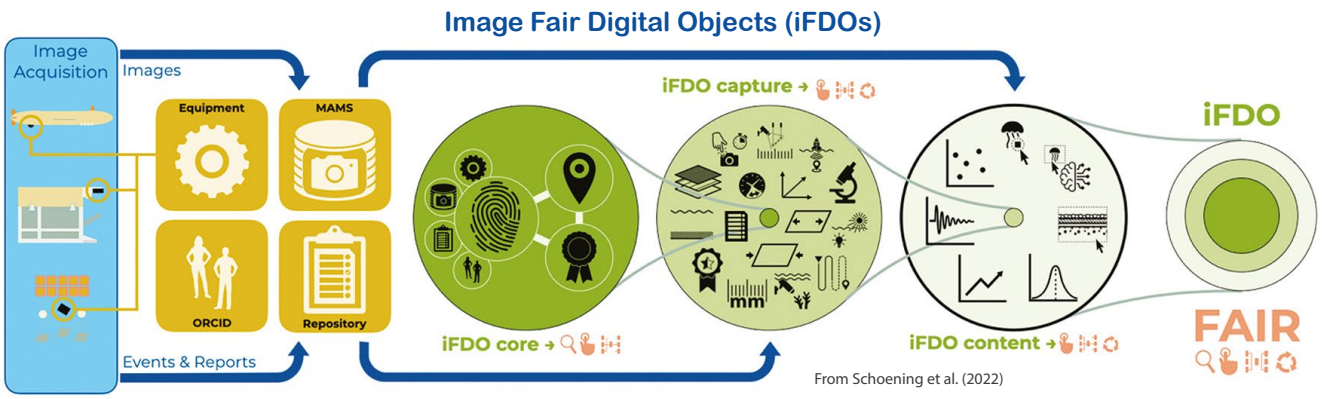


Expanding data capacities

A standardised approach to deep-sea data collection and open-access storage in centralised long-term data repositories and catalogues is essential. User-friendly and accessible platforms and tools that can be used by stakeholders from diverse backgrounds to share data and fulfil commitments to diverse policy initiatives are key.

Acknowledging these requirements, iAtlantic developed a web-based platform that serves as a central repository for geospatial data spanning the entire Atlantic Ocean. The iAtlantic GeoNode promotes a culture of open data, enabling broader access to valuable scientific resources (including environmental data held by industry organisations) that contribute to an inclusive and informed approach to sustainably managing ecosystems in the Atlantic region. iAtlantic also supported the development of an All-Atlantic Ocean Data Community portal (pictured above) as part of the Global Earth Observation System of Systems (GEOSS) Platform to enhance the network of data providers and observers focused on the Atlantic Ocean. The portal empowers users and data providers to establish connections and create customisable sites tailored to specific communities of interest[12].

iAtlantic has championed open access to data and has made significant contributions to advancing the integration of deep-sea datasets by creating a standardised framework for processing marine imagery and making marine image data FAIR (Findable, Accessible, Interoperable, and Reusable)[13]. The lack of universally adopted (meta)data standards for image data collected from the marine environment hampers the objective comparison and impedes the extraction of actionable information. Establishing standardised formats and protocols for deep-sea data and imagery (for example, shown below) enables the integration, interoperability and accessibility across different platforms and systems.



From Schoening et al. (2022)

Policy and governance

The communication gap between (ocean) researchers and decision-makers is a recognised challenge that can hinder progress in achieving sustainable ocean management. Improving scientists' understanding of policy needs and priorities, as well as policymakers' understanding of scientific challenges and limitations is crucial in addressing this lacuna.

One of the overarching goals of iAtlantic is to empower decision-makers with the knowledge and insights necessary to make informed choices regarding the Atlantic marine ecosystem. Improving researchers' awareness of ocean governance processes formed a key strand of the project's capacity building programme, including workshops that focused on science communication for policy processes. These workshops set out to enhance iAtlantic researchers' understanding of key relevant ocean policy processes, such as deep-sea mining and the International Seabed Authority (ISA), fisheries and Regional Fisheries Management Organisations (RFMOs), the UN Decade of Ocean Science, marine biodiversity in areas beyond national jurisdiction (BBNJ), and the climate change treaty, UNFCC. They aimed to equip researchers with the knowledge to identify key stakeholders and opportunities to deliver their findings into policy processes, the skills to effectively communicate their findings to policymakers – including methods to translate complex scientific outputs into accessible lessons for management – and the insight to place their specific research into a broader policy context.

iAtlantic directly engaged with policymakers and other stakeholders, amplifying the role of science in addressing the environmental challenges facing the Atlantic Ocean and providing insights into new science results and their implications for ocean management. At the foundational level, an iAtlantic film[14] explains how deep-sea data collection is carried out and the challenges (and cost) of working in such a remote and dynamic environment – information that is often unknown among policymakers working on ocean issues. At the other end of the spectrum, in October 2023 iAtlantic led the organisation of a 2-day symposium, *The High Seas Treaty: From negotiation to implementation,*[15] which brought together the community of stakeholders involved with the UN's new international legally binding agreement to conserve and sustainably use marine biodiversity of areas beyond national jurisdiction.

iAtlantic also worked with stakeholders to advance sustainable conservation and management practices at national and regional levels. A systematic conservation planning exercise was carried out, designed to integrate ecological and societal values as described in conservation and sustainable management objectives outlined in political commitments, declarations and legal obligations pertaining to the Atlantic marine ecosystems. The outcomes of this exercise will support the evaluation of management strategies across a range of climate change scenarios and identification priority areas, thus supporting the conservation and management regimes to be climate-resilient and inform sustainable development strategies in the Atlantic. The process included targeted stakeholder consultation that successfully heightened awareness and kindled interest among stakeholders, fostering an inclusive and transparent approach. This proactive engagement strategy ensured that a diverse range of perspectives and input from various stakeholders fed into considerations and outcomes.

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Additional resources

iAtlantic website: www.iatlantic.eu

Full list of iAtlantic publications: www.iatlantic.eu/our-work/publications/

iAtlantic open access publications archive: zenodo.org/communities/iatlantic-projectcollection

Atlantic data repository: pangaea.de/?q=iatlantic

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