



iAtlantic

INTEGRATED ASSESSMENT OF ATLANTIC
MARINE ECOSYSTEMS IN SPACE AND TIME

Deliverable 6.3:

Outcomes of regional capacity building, enhancing skills development and knowledge transfer between the North and South Atlantic

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Executive summary

iAtlantic placed capacity building at the heart of its mission, developing and implementing a comprehensive capacity development programme that encompassed both human and technological aspects. Coordinated by the WP6 team and implemented through iAtlantic's technical work packages, this programme aimed to share knowledge, infrastructure, equipment and expertise across the project partnership, and wherever possible opening these learning opportunities to the wider deep-sea research community.

The iAtlantic capacity building programme encompassed hands-on training at sea and in the laboratory, through formal instruction and training events, as well as through more informal individual coaching and mentoring approaches, online learning opportunities and an inclusive approach to the research process – including the transfer of knowledge to end users. Central to the programme's activities was the iAtlantic Fellowship, comprising the cohort of 50+ early career researchers associated with the project.

Capacity development in iAtlantic involved more than training and teaching. Sharing of infrastructure and equipment, creating access to facilities, data and know-how, and providing opportunities for researcher mobility between partner institutions were considered key to ensuring a fully collaborative and inclusive approach to scientific research at ocean basin scale.

This report summarises and reflects on the capacity building activities within iAtlantic that have established, strengthened and enhanced scientific connections between scientists in the North and South Atlantic. It is not a comprehensive report on all capacity development and training activities within the project, but presents specific activities that demonstrate iAtlantic's efforts to advance north-south cooperation and knowledge transfer. The report also offers reflections on different aspects of iAtlantic's capacity building activities, their impact and value, and makes suggestions for improving future endeavours.

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1 Introduction

1.1 Capacity development in marine science: a critical need worldwide

Capacity development – used interchangeably in this report with the term ‘capacity building’ – can be defined in many ways. The United Nations defines it as *“the process of developing and strengthening the skills, instincts, abilities, processes and resources that organisations and communities need to survive, adapt, and thrive in a fast-changing world”*, whilst the European Parliament considers it to represent *“planned development of (or increase in) knowledge, output rate, management, skills, and other capabilities of an organisation through acquisition, incentives, technology, and/or training”*.

In the field of marine science – and particularly deep-sea science – the inequities in scientific capacities between global north and global south are marked. Access to the human, institutional, technical and financial resources required to undertake ocean science remains dominated by researchers and institutions located in high income countries (Harden-Davis et al. 2022). Deep-sea scientific research is an expensive endeavour, requiring long-term national (and sometimes regional) investment in education, research facilities, technology and infrastructure which is underpinned by strong socio-political support that values the acquisition of scientific knowledge. iAtlantic’s approach to integrating scientific approaches and international communities to assess basin-wide ocean ecosystem status (Roberts et al. 2023) provided a unique opportunity to share expertise and build capacity at scale.

Today, more than ever, a concerted, collaborative and unified approach is required to generate the knowledge and data required to address the many challenges and threats affecting the global ocean. Almost without exception, sustainable development and environmental conservation strategies at international, regional and – in many parts of the world – national levels clearly identify the urgent need for capacity development. To deliver on their commitments to these strategies and develop their blue economies in a sustainable manner, developing nations require support to develop capabilities in marine data acquisition, analysis and interpretation, including improved access to technologies, techniques and best practice, and the translation of scientific knowledge into effective management measures and policy decisions. Capacity building is a key pillar of the new UN legally binding instrument under the UN Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (known as the BBNJ Treaty) and is an integral part of the UN Sustainable Development Goals, as well as the Convention on Biological Diversity Kunming-Montreal Global Biodiversity Framework. Regional and sectoral bodies also urgently need access to new information generated by scientific research programmes in order to better manage their respective activities and fulfil their mandates.

In the Atlantic region, capacity building is implicit in both the Belém Statement and the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and Southern Oceans. The Belém Statement calls for activities *“optimising the appropriate use and sharing of research infrastructures, and access to and management of data and platforms; together with emerging methods of data science”* as well as efforts to *“promote and facilitate human capital development and scientific exchange”*. Within that context, Horizon 2020 topic H2020-BG2018-2 called for projects to *“...include capacity building and training with/in countries bordering the South and Tropical Atlantic Ocean”* – a directive that the iAtlantic project has sought to place at the heart of its activities.

1.2 Capacity needs and challenges in the South Atlantic

iAtlantic partners in the South Atlantic comprise organisations located in Brazil, South Africa and Argentina. Scientific and technological capacity in these countries for carrying out deep-sea and open-ocean research is restricted by a number of challenges including (but not limited to) lack of access to

research vessels and infrastructure, absence of stable, sustained and adequate levels of research funding, access to the necessary educational resources and opportunities, and cultural barriers.

A 2021 report into deep-sea research capacity needs in South Africa (Sink et al. 2021) identified a series of key obstacles that limit exposure to and participation in the field of deep-sea research, including *“financial, technical and academic capacity challenges, cultural barriers, limited exposure to the deep sea, a lack of access to ships and deep-sea research infrastructure, the perceived irrelevance of the deep sea, and uniform standards in competitive grants and the publication process that disregard current imbalances in skills, capacity and academic leadership”*. The study also concludes that in South Africa, the equal funding of international research partnerships has been identified as a key enabler for capacity development.

In Brazil, research capacity gaps are compounded by bureaucratic barriers, including customs restrictions on moving research equipment in and out of the country, lengthy and complex permit procedures for scientific expeditions on foreign research vessels in Brazilian waters, and regulations that restrict international scientific collaboration on biodiversity research in Brazil. Whilst the Belém Statement provided a high-level framework in which to facilitate international scientific cooperation, the practicalities of implementation – via projects such as iAtlantic – has highlighted that more needs to be done to make these aspirations a reality.

Addressing these challenges requires a multi-level approach. Whilst projects such as iAtlantic can provide access to research infrastructure, funding for research activities, and opportunities for hands-on training, knowledge transfer and skills development, it is clear that more needs to be done at a higher, political level in the South Atlantic countries to ensure these efforts can be carried out smoothly and effectively, paving the way for continued partnerships and future collaborations.

However, it is overly simplistic to consider capacity development flowing from North to South. iAtlantic recognised and built its team from the expertise across the entire Atlantic and benefited hugely from the skills of our South Atlantic partners. For example, Brazil’s world-leading expertise in cold-water coral taxonomy led to iAtlantic creating a training workshop following our 2022 General Assembly. We describe this workshop and our approach to sharing expertise across our consortium below.

1.3 The iAtlantic approach to capacity building

In recognition of the importance of human and technical capacities in underpinning a truly collaborative and inclusive approach to basin-scale marine science, iAtlantic placed capacity building at the core of its mission. A comprehensive programme, coordinated by the WP6 team and implemented through iAtlantic’s technical work packages, aimed to share knowledge, infrastructure, equipment and expertise across the project partnership. Capacity building activities are coordinated and reported through Task 6.5 in work package 6.

The iAtlantic capacity building programme encompasses hands-on training at sea and in the laboratory, through formal instruction and training events, as well as through more informal individual coaching and mentoring approaches, online learning opportunities and an inclusive approach to the research process – including the transfer of knowledge to end users. Central to the programme’s activities is the iAtlantic Fellowship, comprising the cohort of 50+ early career researchers (see section 3.1) associated with the project, who provide a large part of the scientific horsepower in iAtlantic’s engine. Inclusion of the Fellows in all aspects of the project is central to the project’s approach and underpins its ambition to produce the next generation of marine science leaders.

Capacity development in iAtlantic is about more than training and teaching. Sharing of infrastructure and equipment, creating access to facilities, data and know-how, and providing opportunities for researcher

mobility between partner institutions are key to ensuring a fully collaborative and inclusive approach to scientific research at ocean basin scale.

1.4 Ensuring inclusivity

Maximising inclusivity requires thought and planning on many levels, particularly for a consortium that stretches multiple time zones and encompasses regions that do not always have reliable access to facilities that are taken for granted in the global north. Advances in easy, free video conferencing have greatly eased the challenges of cross-region working, and a small benefit of the Covid-19 pandemic is that online working has become mainstream, minimising (though not entirely removing) the need for in-person meetings, which has considerably lightened the travel burden and has consequently enabled wider participation in events that are almost always now organised in hybrid format. Hybrid events bring the additional benefit of being able to record proceedings, with the resulting video being made available online for those not able to attend the live event – this approach has been used widely in iAtlantic, particularly in relation to the webinar series (see section 3.7 below).

Scheduling of online events at times that enable participation from all project regions has been a primary consideration throughout iAtlantic, even if it means stretching a training event over two or more days in order to keep working hours to a reasonable time for everyone. In some instances, project funding has been used to invest in basic facilities to support participation, such as the purchase of internet dongles to support South African students' participation from home in online events during the early months of Covid lockdown, which they would have otherwise struggled to access. Ongoing issues with reliable electricity supply in South Africa have also required careful planning of project events.

Whilst the iAtlantic Fellows (early career researchers; see section 3.1 below) formed a large contingent of participants at project capacity building events, learning opportunities were open to researchers at all career levels and – wherever possible – opened to suitable participants from the wider Atlantic research community. Productive working relationships with the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) consortium and the Latin American Association of Marine Science Researchers (ALIMAR) has widened participation at iAtlantic's regional training events (see section 3.2).

It should be noted that exchange of knowledge, expertise and skills within iAtlantic has been bi-directional between north and south Atlantic. Whilst much of the technology and facilities transfer has been from north to south, specialist scientific skills that are lacking in Europe and North America have been provided by experts in the South Atlantic. Most notably this has been in the field of cold-water coral taxonomy, with world-leading experts from Brazil providing much-needed knowledge, training and know-how as well as facilitating researcher placements to partner institutions in need of skilled taxonomic support. Training in spatial analysis and management techniques facilitated by experts in South Africa has directly supported work that is contributing to their national marine spatial planning work, in particular supporting more effective spatial management of fisheries and expansion of their existing Marine Protected Area network.

1.5 Scope of this report

This report summarises and reflects on the capacity building activities within iAtlantic that have established, strengthened and enhanced scientific connections between scientists in the North and South Atlantic. It is not a comprehensive report on all capacity development and training activities within the project, but presents specific activities that demonstrate iAtlantic's efforts to advance north-south cooperation and knowledge transfer.

2 Impacts of the Covid-19 pandemic on iAtlantic capacity development activities

The arrival of the Covid-19 pandemic in early 2020 had profound impacts on iAtlantic activities as a whole, resulting in the cancellation or postponement of nearly all seagoing activities for the better part of two years, consequential knock-on delays in experiments, data processing and analysis - and a significant reduction in opportunities for training and development. Even once some seagoing activity resumed in 2021, continued international travel restrictions meant European vessels could not travel to the South Atlantic and our South Atlantic researchers were unable to travel to Europe. Activities in the South Atlantic were hit particularly hard, with the loss of virtually all shiptime to the south-east Atlantic. A significant blow was the reconfiguration of the iMirabilis expedition to comply with international port restrictions - this expedition would have provided hands-on training to a number of iAtlantic Fellows, important data collection opportunities for a number of senior scientists, as well as outreach opportunities during port calls in Namibia and South Africa. The severe restrictions on South Atlantic shiptime caused by the pandemic were raised in a letter from the coordinators of iAtlantic, AquaVitae, ASTRAL, AtlantECO, AtlantOS, SO-CHIC and TRIATLAS to the European Commission in October 2020. Later attempts to secure shiptime for South African partners were hampered by excessively high fuel costs, an unforeseen consequence of the pandemic.

Lockdown restrictions in most iAtlantic partner countries meant that many of the iAtlantic Fellows started their PhD studies or postdoctoral positions in isolation and in some cases in the wrong country (see, for example, [Danielle de Jonge's reflections on starting her PhD in her attic room](#)), and many did not meet their supervisors in person for many months. iAtlantic was unable to convene an in-person annual project meeting in 2020 or 2021, meaning many of the opportunities for peer-to-peer networking and mentoring were lost: the project made excellent use of video conferencing but most agree it is not a full substitute for being able to meet in person.

The extended period of global lockdown and the subsequent impacts on people's workloads and working arrangements (even after restrictions were lifted) prompted a reconsideration of some aspects of the iAtlantic capacity building programme. For example, the mentoring programme that was planned was significantly scaled back on the basis of feedback from both potential mentors and mentees who felt unable to commit to a formal structured arrangement, both during the lockdown period and in the post-pandemic world when efforts were focused on catching up on experiments and analyses. A number of iAtlantic Fellows explained that the open culture of collaborative and working within the project (and their home institutions) meant that they already felt well-supported in their work by their peers and considered that they felt able to ask if they needed further support.

The iAtlantic community embraced the virtual world and used video conferencing extensively for hosting webinars, training workshops, connecting from research vessels whilst at sea, convening working group meetings, and even enjoying an online icebreaker drinks reception (including domestic pets) during the 2020 annual meeting.

3 Elements of the iAtlantic capacity building programme

iAtlantic's capacity building programme was designed to maximise learning and development opportunities across the spectrum of researchers in the project community and beyond. A series of technical workshops (both in person and online), webinars and at-sea capacity building opportunities were organised through the scientific work packages, with support and facilitation by WP6. These activities broadly spanned five themes: 1) transfer of technologies, facilities and experimental techniques, 2) researcher mobility, 3) analytical techniques, data integration, interpretation and management, 4) ocean policy and governance, 5) transferable research skills. In addition, two events were planned to address region-specific capacity needs in the central Atlantic/west African region and in South America.

Whilst development of human skills through learning and training was a prominent part of iAtlantic's capacity building activities, considerable effort was devoted to enhancing and expanding technological capacities – not only across the Atlantic region, but also between scientific sub-disciplines. Tangible examples of technology transfer are given in Section 3.6, but the highly multi- and interdisciplinary nature of the project also provided fertile ground for adaptation of techniques and approaches to solve new research questions at a variety of scales. This quiet evolution of scientific process is often unrecognised, arising through problem-solving at sea or in the lab, or as a consequence of a chance conversation between researchers at a conference. It is nevertheless an important component of scientific advance and innovation, which flourishes in a project environment that prioritises collaboration, partnership and trust.

3.1 The iAtlantic Fellowship

It was recognised at proposal stage that early career researchers (ECRs; loosely defined here as researchers within 7 years of receiving their first degree) would form a significant and vital component of the scientific workforce within iAtlantic. In recognition of this, the iAtlantic Fellowship was established in the early months of the project, comprising the cohort of MSc students, PhD candidates, postdoctoral researchers and technical support staff involved with (but not necessarily funded by) iAtlantic. Over the course of the project, membership of the Fellowship rose to more than 50 researchers, representing most partners in the Consortium and including individuals from outside the partnership who have close research collaborations with the iAtlantic team.

The Fellowship not only recognises the important contribution that ECRs make to the success of project like iAtlantic, it also aims to raise the profile of the new generation of ocean researchers at international forums, working in synergy with similar initiatives such as the UN Ocean Decade's Early Career Ocean Professionals ([ECOPs](#)) network, the Deep Ocean Stewardship Initiative ([DOSI](#)), the Deep Ocean Observing System ([DOOS-DOERS](#)) community, and the Canadian Healthy Oceans Network (CHONE).

The iAtlantic Fellowship has a dedicated section on the [iAtlantic website](#), and as a community the Fellows organised their own webinar series, *Follow the Fellows*, to discuss emerging science results and draw on the collective expertise of their peers to get feedback, help resolve research challenges, and tap into new resources.

Across the project, conscious efforts have been made to ensure ECRs from all iAtlantic partner institutions are involved and engaged not only in the research process itself, but also in the planning and decision-making involved in implementing such a complex research programme. Fellows were an integral part of the research teams and participated fully in the regular technical meetings convened by each of the work packages. They were also given prominent roles in the project's annual meetings, and

regularly featured in outward-facing dissemination events such as webinars and stakeholder engagement meetings. Fellows also authored a significant proportion of the articles published on the iAtlantic website and biannual newsletter, and contributed a number of training videos that are available on the iAtlantic [YouTube channel](#).

The Fellows were regularly asked for feedback on their experiences as part of the iAtlantic project. Beatriz Vinha is a postgraduate researcher at the University of Salento in Italy and the Spanish Institute of Oceanography. She joined the iAtlantic Fellowship in 2020, working on habitat mapping and trophic ecology of the unexplored cold-water coral communities offshore West Africa. She explained: *“Being an iAtlantic fellow means being part of a supportive early-career network that fosters scientific collaboration and exchanges across different disciplines, geographical regions and generations. It means being part of a group where we can share experience with peers at the same career level, but where we can also benefit from the guidance and advice of senior iAtlantic scientists, challenging us to be on the edge of scientific innovation. I believe the inter-generational and inter-regional experience of iAtlantic is essential to help shape a more inclusive and multidimensional next generation of deep-sea scientists.”*

3.2 Regional capacity building workshops

The original iAtlantic capacity building programme included two regional capacity building workshops to address region-specific capacity needs: one for the North Atlantic region, held in Cabo Verde (with focus on African participation and in partnership with the WASCAL consortium), and one in South America in close collaboration with the COLACMAR conference.

3.2.1 Regional capacity building workshop for the North Atlantic

This regional capacity building workshop took place at the Ocean Science Centre in Mindelo, Cabo Verde on 23-26 August 2022, after a lengthy postponement due to Covid restrictions (see section 2). Focusing specifically on hydroacoustic technologies to characterise pelagic ecosystems and to support their sustainable management, the workshop was organised and led by GEOMAR (Dr Björn Fiedler) in partnership with the Coastal Ecosystem Monitoring in Cabo Verde (CEM_CV) project - a Meerwissen initiative for the effective management and conservation of Africa’s ocean and coasts.

A total of 30 participants attended the workshop, hailing from Cabo Verde and the West African region. Among this group were six experts from the West African subregion (Senegal, Guinea-Bissau & Mauritania) and Europe, and a number of Masters students from the ‘Climate Change and Marine Sciences’ group at the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) consortium.

The 4-day workshop comprised both classroom and field exercises, including time at sea for practical training on how to acquire hydroacoustic data with ship-mounted echosounders. Participants learned how to design a small survey, collect the necessary hydroacoustic data at sea, and then how to process, visualise and interpret the results. The last day of the workshop was dedicated to a dialogue amongst countries from the subregion to share their experiences in using hydroacoustic data for regional fish stock management efforts, and to discuss how hydroacoustic monitoring of biological resources could provide a basis for stronger collaboration between neighbouring countries.

Shortly after the workshop, the first hydroacoustic survey was completed around the island of Santa Luzia in Cabo Verde. The survey was carried out by trainees using the data collection, processing and visualization skills acquired during the workshop. The survey data and results formed part of a Master thesis at WASCAL and results shared with local decisionmakers.

A report of the workshop is [available here](#) and a short summary video is available at https://twitter.com/OSCM_/status/1664381597905199106.

3.2.2 Regional capacity building workshop for South America

The original plan for this workshop envisaged a 2-day event, organised by iAtlantic partners Gianni Consultancy and UNIVALI, held back-to-back with the biennial Latin American Congress of Marine Sciences (COLACMAR) conference scheduled for September 2020. However, the Covid pandemic resulted in the conference being pushed back to November 2022 in Panama City, by which time discussions with iAtlantic partners in South America concluded that the funds set aside to support such an event would be better directed to address regional capacity needs in a different way. However, there was interest in iAtlantic organising and delivering a shorter 'mini-course' within the COLACMAR programme, focused on the interface between deep-sea research and policy. Matthew Gianni (GC) and Angel Perez (UNIVALI) delivered this workshop (in Portuguese and Spanish), titled '*Deep-sea research: Breaking new ground at the frontiers of international law, policy and regulatory action*' on 20 September 2022 to a group of around 20 participants from the Central and South American region.

A way forward for the iAtlantic South American regional capacity building workshop were discussed at the iAtlantic General Assembly in Florianópolis, Brazil in October 2022, and regional partners (including South African partners) signalled a strong preference for practical training on the assembly, operation, and data processing of the Azor Drift-Cam system, developed by the iAtlantic team at IMAR in the Azores. With strong support from the Steering Committee and approval from the European Commission, Seascope Consultants, UNIVALI and IMAR developed a plan to facilitate this, assisted by the injection of additional project funds to invest in a Drift-Cam system for use by Brazilian researchers. The training workshop took place in the Azores in June 2023, and is described in more detail in Section 3.3.7.

3.3 Technical capacity building workshops

A key component of iAtlantic's capacity building programme centred on a series of technical capacity building and training workshops, organised by various iAtlantic partners and supported through WP6. These workshops were designed to provide necessary skills and know-how to researchers within the project to support their research and broaden their skill base in recognition of the increasingly multidisciplinary nature of marine science in today's world. Table 1 provides an overview of the training and capacity building workshops organised under the iAtlantic banner; selected highlights are presented below.

Feedback from the iAtlantic community indicates that the iAtlantic technical training workshops were greatly appreciated by all partners, but particularly those in the South Atlantic. A Brazilian colleague commented that in-person events were particularly worthwhile "*...because apart from the knowledge that is being shared, there is the unique opportunity to know and talk to people in person. Many Brazilian students were thrilled to meet and talk with well-known scientists such as Murray, Telmo, Marina and others in the Cold-water coral taxonomy and Azor Drift cam workshops. And also to share the classroom with iAtlantic Fellows from South Africa, Germany, UK, Spain, Portugal and so on. It made them feel like students of the world, and not only students of Brazil. In Brazil it is much more difficult to travel than it is in Europe, so iAtlantic brought this unique opportunity and I can tell they are even more keen on finishing their degrees and focusing on their careers in science, not to mention putting more effort in learning English as the international language of science*".

Resources provided during training events have enabled workshop participants to share their newly acquired skills with colleagues back in their home institutions, creating the so-called 'multiplier effect' – the ultimate goal of effective capacity development. Brazilian researcher Marcos Silva from UNIVALI explained his intentions following his participation in the Azor DriftCam workshop: "*I intend to provide training to the UNIVALI team, demonstrating all the steps to carry out a high-resolution mapping of cold-*

water coral habitats. The main objective of the training is to enable the team to carry out investigation activities, processing and analysis of high-resolution data in cold-water coral habitats, using video footage, photogrammetry and the annotation scheme of the Biigle platform as tools, as well as the knowledge acquired in the Azor drift-cam workshop. At the end, professionals are expected to be trained to develop all activities related to the process of mapping deep sea habitats. From image processing in the 3D model reconstruction stage, generation of point clouds and extraction of geomorphometrics from terrain variables, to eventual cataloging of the species of interest on the Biigle platform.”

3.3.1 iAtlantic Ocean Time Series Workshop: Online, 15-18 June 2021

This 4-day workshop was a joint event between iAtlantic and the MSc programme on Climate Change and Marine Sciences at the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), organised by iAtlantic’s Lea-Anne Henry (U. Edinburgh) and Marjolaine Matabos (Ifremer). Tuition was led by renowned numerical ecologist Prof. Pierre Legendre, Professor of Quantitative Ecology at Université de Montréal, Canada.

Originally planned as an in-person event in Cabo Verde (to be held back-to-back with the North Atlantic regional capacity building workshop), the global COVID-19 pandemic demanded some innovative thinking and replanning in order to deliver a highly technical learning experience using video conferencing across several time zones.

The training aimed to strengthen the capacities of marine scientists to use statistical methods to visualise, analyse and explain drivers of change in ocean time series datasets in order to interpret the changes we have seen and predict future changes. Targeted at researchers who already had some understanding of statistics and experience using the [R software](#), the workshop had a truly international flavour with 60 participants from 23 countries, including Cabo Verde, Ghana, Senegal, South Africa, Portugal, UK, Ireland, Brazil, Argentina, Germany, Benin, Canada, Namibia, Spain, the Netherlands, Guinea, Switzerland, Iceland and Italy.

The workshop schedule was intense: in addition to the daily online sessions, which started with an initial plenary Q&A session followed by breakout groups to work on specific practical exercises, participants had to prepare for each live session by reading a number of introductory documents and watching a series of pre-recorded video lectures prepared by the workshop instructors. The daily practical sessions worked through a series of exercises using R software on pre-supplied datasets, but participants also had the opportunity to work on their own datasets during the sessions. Help and advice was on hand at all times during the workshop, with instructor Pierre online to answer questions along with breakout room assistants Garance Perrois (Ifremer), Johanne Vad (U. Edinburgh) and Loic Van Audenhaege (Ifremer) – all iAtlantic Fellows.

Feedback from participants showed that the workshop was overall very well received and fulfilled its objectives. Participants, however, also highlighted that the workshop program covered many advanced analyses and was more beneficial to advanced R users with strong pre-existing statistical backgrounds. The workshop booklet, slides used during the pre-recorded lectures, additional reading material and the practical materials are available on the iAtlantic website in legacy: <https://www.iatlantic.eu/events-calendar/wp3-timeseries-workshop/>

A senior Brazilian scientist commented that “It was a real pleasure to be a ‘student’ in Pierre Legendre’s course. I immediately applied the old and new techniques into papers I was writing. I also hear the same feeling from a colleague who teaches statistics at UNIVALI. Again, both of us have read his books dozens of times but having a chance to directly interact with him gave us a unique perspective.”

3.3.2 iAtlantic Workshop on Ocean Governance: Florianopolis, Brazil, 9 October 2022

iAtlantic partner TMG organised and led the iAtlantic Ocean Governance Capacity Building Workshop on 9 October 2022 in Florianopolis, Brazil, with support from Seascope Consultants, Gianni Consultancy and UNIVALI. The workshop brought together around 20 researchers (including 6 from Brazil/South Africa) to enhance understanding of key ocean governance processes within the Atlantic region, as well as to boost the researchers' capacity to identify opportunities and approaches to impact policy with their scientific findings.

The workshop provided information on the importance of translating scientific findings to policy and regulatory action. Participants discussed the various means and methods of identifying and communicating scientific information relevant for policymakers and regulators and how to effectively bring that information into regulatory processes. The workshop provided background on key global processes, such as the development of the deep-sea mining code by the International Seabed Authority (ISA), fisheries and Regional Fisheries Management Organisations, the UN Decade of Ocean Science, negotiations on a new UN treaty for the protection of marine biodiversity in areas beyond national jurisdiction (BBNJ), and the UN climate treaty under UNFCCC. A special presentation on perspectives in the SW Atlantic was given by Angel Perez (UNIVALI), who outlined recent developments in ocean policy at the national (Brazilian) and regional levels.

Practical sessions included an exercise in distilling key messages from scientific results, and group work on identifying the necessary steps and appropriate formats to communicate science to a suitable policy platform. In this session, participants identified opportunities to create policy impact based on their own research results, and then sought to map out pathways to achieve that impact.



Participants at the ocean governance workshop in Florianopolis, October 2022.

3.3.3 Deep-Water Coral Taxonomy Training School: Florianopolis, 13-17 October 2022

This workshop drew on the world-leading taxonomic expertise of Alberto Lindner and colleagues at Universidade Federal de Santa Catarina (UFSC) to deliver a 5-day training programme covering aspects of taxonomy, diversity and distribution of scleractinians, stlyasterids, octocorals and black corals. About half of the workshop was focused on hands-on activities in observing deep-water coral specimens, particularly from Brazil, with the remaining time devoted to lectures. A total of 21 participants attended the workshop, representing both iAtlantic and the wider scientific community, as well as a range of scientific expertise. This training school was organised in collaboration with the [Marine Animal Forest COST Action](#) which provided travel bursaries for 7 ECRs, including 4 from outside the iAtlantic project.

These bursaries were awarded through an open call and competitive application process administered by the WP6 lead partner, Seascope.



Scenes from the cold-water coral taxonomy workshop, UFSC, Brazil, in October 2022

3.3.4 Translation of Science to Inform Policy - Lessons learned from South Africa: Cape Town, 14-16 March 2023

Nelson Mandela University/South Africa National Biodiversity Institute (NMU/SANBI) organised and hosted this 3-day science to policy training workshop for 23 participants from South African universities and marine organisations, with additional travel funds for national participants provided by the SeaMap project – a project funded through South Africa’s National Research Foundation’s Biodiversity Information Program. The workshop focused on key marine biodiversity issues in the SW Atlantic region and aimed to: (1) introduce and build an understanding of the science to policy value chain, (2) build understanding of mainstreaming and share SANBI lessons in this context and (3) build skills in science communication for policy uptake. The programme included elements on biodiversity mainstreaming, “making the case for biodiversity” and biodiversity messaging. Group exercises allowed participants to engage with the course content, share experiences, explore ideas and try out practical applications of theoretical concepts.

Six specific case studies were used to help advance areas of work that participants brought to the workshop. These spanned mainstreaming and community-based initiatives, science communication and messaging towards specific objectives:

- Two groups focused on fisheries and explored mainstreaming ideas for small-scale fishers and recreational fishers, including understanding and defining the core challenges, new ideas in messaging and interventions to solve specific challenges, and application of tools and approaches to move science across the science-policy interface.
- Two groups focused on making the case for biodiversity: one for leveraging funding to support marine taxonomy as a foundational science, and another in reframing decision-maker understanding, resource allocation and decisions for the deep sea.
- A fifth group worked on enforcement challenges in coastal resources, developing new ideas, motivations and messaging to empower communities to solve poaching challenges.
- The sixth group worked on building a case for a marine World Heritage Site in South Africa, laying out an ambitious vision and identifying key audiences, inclusive consultations,

engagement processes and key messages. They identified a network of sites that would benefit local communities whilst securing natural and cultural assets in the marine and coastal environment.

Workshop feedback indicated that participants found the workshop inspirational and empowering; further post-workshop evaluations identified a need for more workshops of this nature, and a desire for this type of science-policy training to be included in science curricula.

3.3.5 MARXAN workshop, South Africa, 11-14 April 2023

An online MARXAN training workshop (MARXAN being specialist software designed to aid decision-making in conservation planning) was organised by Nelson Mandela University on 11-14 April 2023 to build systematic conservation planning experience in support of emerging case studies. Led by NMU's Linda Harris, participation was expressly targeted at South African and Brazilian scientists, with five participants (two from South Africa and three from Brazil) comprising postgraduate students, early career researchers and more established professionals. The South African participants are contributing to current national systematic conservation planning activities where new elements encompass the inclusion of data to represent Culturally Significant Areas in marine spatial planning, and Vulnerable Marine Ecosystems data to support more effective spatial management of fisheries and to inform the expansion of Marine Protected Areas. A senior iAtlantic scientist from Brazil commented that "*A PhD student in my lab participated in the iAtlantic Marxan workshop in South Africa in April 2023. She needs to apply the method in a chapter of her thesis and the workshop came miraculously on time, giving her energy, expertise and resources to finish her work.*"

3.3.6 Cold-water Corals in Aquaria: Edinburgh, 3-4 June 2023

This workshop took place in the margins of the International Symposium on Deep-Water Corals in Edinburgh on 3-4 June 2023, following a lengthy postponement due to Covid restrictions. Organised and led by Marine Carreiro Silva and Maria Rakka from IMAR, the workshop comprised a series of lectures from cold-water coral experts covering topics such as optimal aquaria set-up for experimentation, experiments under changing ocean conditions, measuring growth and metabolic response, dealing with the different life stages of corals, ecophysiology, and protocols such as feeding routines. 38 participants attended the workshop in person, with a further 21 attending remotely via video conference (total 59 participants). This group included a number of participants from outside the iAtlantic partnership, many from USA and Canada but also from as far afield as New Zealand and Taiwan. On Day 2, in-person participants enjoyed a field excursion to the nearby St Abbs Marine Station where they were able to observe practices in manipulation of carbonate chemistry, temperature and oxygen in the aquaria tanks there. This workshop was organised in collaboration with the [Marine Animal Forest COST Action](#), which provided travel bursaries for 7 participants via a competitive application process managed by iAtlantic WP6.



Participants at the cold-water corals in aquaria workshop, on their visit to the St Abbs Marine Station. June 2023.

3.3.7 Azor Drift-Cam training workshop: Horta, 5-8 June 2023

Focused on training researchers in the assembly and operation of the [Azor drift-cam](#), this workshop took place on 5-8 June 2023 in Horta, Azores. A total of 12 iAtlantic researchers (of all career stages) hailing mainly from Brazil and South Africa took part in the workshop, which was a partial replacement for the regional capacity building workshop for South America that was originally planned (see section 3.2.2).

The key aim of this workshop was to enable transfer of this low-cost technology to the research community in the South Atlantic, where access to large infrastructure such as research vessels, ROVs and other expensive survey equipment can be challenging. The Azor drift-cam enables acquisition of high-quality video footage of ecosystems in waters depth of up to 1000m using off-the-shelf components and simple deployment protocols that do not require overly specialised vessel facilities.

Organised and led by the Azores Deep-Sea Research Group at IMAR, the hands-on course provided participants with the necessary training and know-how to build a replica of the Azor drift-cam system, as well as the capacity to safely operate this cost-effective system from small local vessels to obtain high-resolution underwater video images of deep-sea habitats.

The workshop was split in four different sections, which covered all the aspects needed to understand how the Azor drift-cam works. The week started with an introduction on the concept, the rationale and the guiding principles that were followed during the construction of the different prototypes that led to the final design of the Azor drift-cam. Next, a series of practical sessions showed participants how to assemble all the parts of the metal structure to build a functional replica of the system, including troubleshooting advice to identify and resolve small problems that could potentially arise during deployment of the system at sea. The workshop also included a practical session on how to run the software used with the Azor drift-cam (including the ArcGIS program to collect positioning data) and how to setup the depth/temperature sensors and the action cameras. Finally, the workshop included two half-day surveys on board a small local vessel to demonstrate deployment of the instrument in real conditions and how to operate the system to effectively collect video footage of deep-sea benthic habitats.

iAtlantic project funding has allowed Brazilian partner Universidade Federal do Espírito Santo (UFES) to invest in the drift-cam components necessary to build one of the replica systems during the workshop, and this system will now be used in offshore ecosystem surveys (see Section 3.6.2).

A senior Brazilian scientist who attended the workshop commented: “The Azor Drift Cam workshop was a great opportunity for direct technology transfer. Getting hands-on training in building a camera system was a reality check that we really needed in Brazil to keep up with deep-sea research, perhaps without being dependent on impossible ROV opportunities. We are all very motivated to try and build and adapt these low-cost cameras in Brazil, meaning that the technology transfer experience was successful.”



Workshop participants assembling the Azor drift-camera apparatus in Horta, June 2023.

3.3.8 Capacity building workshops on using geospatial data (iAtlantic GeoNode)

Two capacity building workshops on using geospatial web services (provided by the iAtlantic GeoNode) were convened by Seascope Belgium through WP5, both using scripting languages (Python) as well as dedicated GIS software. The workshops took place during iAtlantic’s annual meetings: online in September 2020, and in person in Brazil in October 2022.

The iAtlantic GeoNode offers a platform to search, visualise, download and share geospatial data in the iAtlantic case study areas with the aim to support the delivery of iAtlantic research and to promote the use and impact of iAtlantic research outputs to wider stakeholders. The GeoNode has been populated with a wide range of pre-existing geospatial dataset in the Atlantic Ocean, including biological, environmental and biogeographic data, as well as information on human use, management and

conservation, from diverse sources (e.g. EMODnet, Ifremer, GEOMAR, CMEMS, Global Fishing Watch, OBIS, H2020 ATLAS project etc.). Furthermore, geospatial data outputs from iAtlantic research are being published (with the desired level of access), allowing them to be visualised in an interactive web map, downloaded in a range of geospatial data formats and shared with stakeholders.

The workshops provided interactive demonstrations of how to make use of the iAtlantic GeoNode, approached via two different modes of interacting:

- Tier 1: Using the iAtlantic GeoNode online platform to search, visualise, download and share geospatial data. The recording of the presentation of this part is [available online](#) for future reference
- Tier 2: Using the iAtlantic GeoNode within a geospatial data analysis environment - either in a GIS software (e.g., QGIS2) or programmatically through a scripting language (e.g. Python 3). The content of this part of the training is available on [Github](#).

The workshops were open to all iAtlantic partners and taken up by participants in both North and South partner institutions.

3.3.9 Introduction to Ocean Governance: Insights into Ongoing Policy Process and Lessons for Early Career Professionals: online, 6-7 September 2023

This 2-day virtual event, hosted by the COBRA network and co-organised with iAtlantic partner TMG (Ben Boteler), provided a general introduction to ocean governance for scientists and other stakeholders, covering key policy processes and ongoing discussions in selected policy fields relevant to ocean science. Speakers from the iAtlantic WP6 team included David Johnson (SC), Vikki Gunn (SC) and Matt Gianni (GC). Topics covered in the event include the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), fisheries including key global and regional processes, deep-sea mining and the International Seabed Authority, and the global agreement covering biodiversity in areas beyond national jurisdiction (the BBNJ Agreement). The event offered insights into capacity development and scientific outreach, as well as opportunities for engagement including from early career professionals. The course attracted more than 200 registrants from all over the world, including many early career researchers and scientists from non-marine disciplines. A recording of the event is available online at <https://cobra.bigelow.org/virtual-short-course-september-2023/>

3.3.10 Methods to process multibeam bathymetry data: online, 29-30 August 2023

As a replacement for the bathymetry data acquisition training envisaged as part of the original iMirabilis expedition, a highly bespoke support clinic was organised to help researchers with specific issues around processing of bathymetry datasets. Organised online by experts at AWI, specialist support was provided to a small number of researchers, including one participant from Brazil and one from South Africa. Further one-to-one support was provided to ensure their specific needs were addressed and issues resolved.

Table 1: Overview of iAtlantic capacity building workshops (adapted and updated from Table 7 in the iAtlantic DoW)

Workshop title/description	WP	Lead	Location	Participants (of which S.Atlantic)	Timing (actual)	Comment
Habitat Classification and Species Distribution Modelling: Workshop to define common methods for ocean mapping at basin, regional and local scale	2	NOC	UK	18 (1)	M01	Completed during kickoff meeting, June 2019
Machine Learning: Workshop bringing together users and developers of machine learning methods to address benthic image data interpretation bottlenecks	2	GEOMAR	Canada	45 (5)	M04	Completed during international Marine Imaging Conference, June 2019
OGCM Analysis and Lagrangian Modelling Techniques: Practical lectures in running OGCM models	1	GEOMAR	Germany/ hybrid	14 (0)*	M06	Completed Jan 2020
Handling, Harvesting and Analysing Big Data: Advanced scientific programming	7	UNIHB	Online	50 (0)*	M18	Completed online in October 2020
iAtlantic Ocean Time Series Workshop - Statistical Approaches for Timeseries and Tipping Points: Expert workshop to define common statistical approaches for timeseries and tipping points analysis	3	UEDIN, IFREMER, GEOMAR	Online	60 (36**)	M26	Completed online in June 2021
Deep-sea research: Breaking new ground at the frontiers of international law, policy and regulatory action	6	GC, UNIVALI	Panama	20 (20)	M40	Mini-course held as part of COLACMAR conference programme, 20 Sept 2022
Capacity building workshop on ocean governance	6	TMG	Brazil	20 (6)	M41	Held prior to iAtlantic GA, 9 Oct 2022.
iAtlantic Deep-water Coral Taxonomy Training School: Workshop on the in taxonomy and biodiversity of deep-water corals	2	UFSC	Brazil	25 (9)	M41	In partnership with MAF-World COST action who provided travel bursaries for external EU participants, 15-17 Oct 2022

Translation of Science to Inform Policy: Navigating the Science to Policy Space to Influence Decision-Making: lessons learned from South Africa	6	NMU	South Africa	35 (35)	M46	Held in collaboration with SA SeaMap project on 14-16 March 2023
MARXAN workshop, South Africa	5	NMU	Online	5 (5)	M47	
Cold-water Corals in Aquaria: maintenance and experimentation. Workshop on husbandry of cold-water corals and their larvae and best practices for laboratory experiments in the laboratory	4	IMAR	UK/ hybrid	59 (4)	M49	Postponed due to Covid but finally held in conjunction with the Deep-Sea Coral Symposium in Edinburgh on 3-4 June 2023
Drift-Cam workshop: training for South Atlantic researchers to collect and process high-quality seafloor video using a low-cost camera system	2	IMAR	Azores	12 (10)	M49	5-8 June 2023: partial replacement for South American regional CB workshop
Multibeam Data Processing: Workshop on methods to process multibeam data	2	AWI, GEOMAR	Online	10 (2)	M51	Online course, 29-30 August 2023
GEOnode training workshops: using geospatial web services	5	SBE	Online/in person	25	M12 & M41	Held in the margins of the iAtlantic Annual Meetings in 2020 (virtual) and 2022 (Brazil)
Spatial Assessment of Environmental Data: the use of spatial planning and optimisation tools to inform management activities	5	IMAR	Online	20 (5)	M52, M53 & TBC	Organised as a series of 3 online webinars in late summer/autumn 2023, based on the outcomes of the iAtlantic SCP work (WP5)
<i>Hands-on lectures in Multibeam Mapping: Ship based training in multibeam data collection</i>	2	<i>IEO</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>Cancelled as consequence of Covid-19 and the iMirabilis reconfiguration. Later attempts to reschedule onto other cruises were not feasible.</i>

*These workshops were open to South Atlantic participants but none registered

** Number includes 16 participants from West African nations and 20 from South Atlantic countries

3.4 Sea-based training

Seagoing experience is a hugely important element in the developing careers of marine scientists and technicians, not only in terms of successful sampling and data collection from a research vessel, but also in the planning, processes and logistics involved in executing a successful sea-going expedition. iAtlantic's capacity building programme encompassed the full suite of offshore survey and sampling techniques used in multidisciplinary research expeditions, including pre-cruise planning, sampling strategies, experimental design, contingency planning, and shadowing of principal scientists during cruises – all essential skills for the next generation of expedition leaders.

As well as training on the project's 'routine' scientific cruises, two large-scale, high-profile "Flagship Demonstrator Capacity Building Cruises" were planned during the project which prioritised training alongside science as equal expedition objectives. Unfortunately, the Covid pandemic forced significant reshaping of these plans (see section 2), ultimately resulting in just one scaled-back demonstration cruise – iMirabilis2 – which took place in July-August 2021 (see below). However, despite stringent limitations on international travel and research vessel movements during the two-year period from early spring 2020, iAtlantic managed to deliver significant seagoing training thanks to the efforts of project partners and their national funding agencies in rescheduling expeditions and securing alternative shiptime opportunities.

During the project (at the time of writing this report) iAtlantic has been involved in more than 75 expeditions of varying size and duration in the North and South Atlantic. Unfortunately, due to the fallout from the Covid pandemic and despite exhaustive efforts, iAtlantic was unable to execute a research cruise in the south-east Atlantic, meaning that at-sea training in South African waters was unfortunately not possible. However, opportunities did arise for a small number of South African ECRs to join other iAtlantic expeditions later in the project, and the SEAmester programme, run by Isabel Anson at University of Cape Town, launched training expeditions in 2019, 2022 and 2023 (see section 3.4.2).

For our Brazilian partners, at-sea activities were badly affected not only due to Covid but also to internal logistical issues. However, the one cruise they did execute (BR10 in December 2022; see Section 3.4.4 below) highlighted that seagoing training is considered by most marine scientists to be the most productive and valuable capacity building activity. Scientists involved in this expedition explained that the experience brought together the benefits of the various iAtlantic technical training workshops with the reality of doing science in the ocean. One senior Brazilian scientist explained that the iAtlantic project provided a framework that was understood by Navy people, students and the PIs on board the ship, which helped everyone to collaborate and work together to solve the technical challenges they faced during the cruise.

In addition to the first-hand experience of living and working on board a research vessel, iAtlantic facilitated remote participation in cruise activities, through its own outreach campaign during the iMirabilis2 expedition (section 3.4.1), and also by working in partnership with NOAA during the 2022 'Voyage to the Deep' expedition in the mid-Atlantic (section 3.4.5).

Video footage from the iMirabilis2 and other expeditions will be used to produce two versions of a film explaining what a deep ocean expedition entails: a five-minute overview for policy makers and a more detailed 15-minute film for students and members of the public. These films will include input from the Dynamic Earth science centre in Edinburgh, Scotland, where it will form part of their ocean educational portfolio. It will be freely available on the iAtlantic YouTube channel and shared across the consortium.

3.4.1 iMirabilis2 expedition, July-August 2021

Led by iAtlantic PIs from IEO-CSIC, NOC and SAMS (formerly HWU), this Flagship Demonstrator Cruise took place during July-August 2021 and represented a major iAtlantic capacity building activity.

Due to Covid-19, the configuration and scope of the expedition changed considerably from the original plan, with the RV *Sarmiento de Gamboa* restricted to calling at Spanish ports only and limiting the expedition to the North Atlantic region only, rather than making the full transect from Vigo to Cape Town.

The expedition was executed in two legs:

- **Leg 0** (Vigo-Las Palmas, 23 – 31 July 2021) was carried out in partnership with EMEPC and dedicated to ROV surveying of seafloor geology with the ROV *Luso*. Two iAtlantic Fellows and two external early career researchers were involved in ROV training during this leg, and a small team of seabird ecologists from the NGO [Projecto Vito](#) in Cabo Verde received training on seabird surveying and census.
- **Leg 1** (Las Palmas – Las Palmas; 1-31 Aug 2021) focused on iAtlantic research on deep-sea ecosystems around Cabo Verde.

Five iAtlantic Fellows were able to join Leg 1 of the expedition (considerably less than originally planned); due to international travel restrictions we were not able to accommodate scientists from the South Atlantic on the ship. Due to these limitations on in-person participation, a much higher emphasis was placed on the online coverage of the expedition and strategies were put in place to maximise learning opportunities through remote participation.

A [dedicated area of the iAtlantic website](#) was set up ahead of the expedition to host a wide range of resource materials, many of which were written by iAtlantic Fellows. A special virtual event '[iMirabilis2: Deep Sea to Desktop](#)' took place on 8 July 2021 as part of the UN Ocean Decade's Laboratory on 'An Inspiring and Engaging Ocean' to officially launch the online coverage of the expedition. This event featured speakers from the expedition science team (IEO, NOC, UEDIN, HWU – including the Fellows involved in the expedition), as well as local collaborating partners in Cabo Verde, and attracted an audience of 60 people from around the world. The video of the session (and also the related Follow the Fellows webinar on iMirabilis2) is available to view on the [iAtlantic webinar archive page](#).

The expedition provided capacity building activities for both expedition participants and remote learners and generated a library of video tutorials for at-sea activities that remain available through the website. iAtlantic Fellow Kelsey Archer Barnhill (UEDIN) acted as the main onboard outreach liaison point throughout the expedition and authored the vast majority of the [expedition blog entries](#) as well as many of the video tutorials. She also hosted a Reddit AMA (Ask Me Anything) session during the final week of the expedition and posted regularly to iAtlantic's social media accounts on Twitter, Facebook and Instagram.

A "Ship-to-Shore" buddy scheme was established, where the Fellows on the ship teamed up with Fellows back on shore in Brazil, Cabo Verde, Columbia, Ghana, Portugal, South Africa and Togo to provide a more detailed view of life and research aboard the ship. Daily updates were shared using WhatsApp, sparking some interesting questions and discussions, and a weekly group video call allowed more detailed debate about the research. This scheme had [very positive feedback from the participants](#), and generated interesting ideas for future expeditions. One participant of the scheme commented *"Research groups all over the world should run a ship to shore buddy program on all research expeditions big or small. This platform has created a space for relaxed interactions between emerging scientists from various parts of the world to exchange ideas and learn new skills. The weekly Zoom calls were immensely interesting and have given me insights into the challenges and opportunities of multidisciplinary deep sea research using state of the art technologies. I hope to be part of many more programmes like this one."*

In addition to the marine science training, a small team of seabird scientists from Cabo Verde joined the ship to receive training on at-sea seabird observation and recording. Securing berths on research vessels is a rare opportunity for seabird scientists, and the data collected will be used to inform marine wildlife conservation strategies in Cabo Verde waters.

Full details of the capacity building activities during the iMirabilis2 were published in an open access paper: Barnhill et al. (2023).

3.4.2 The SEAmester programme

SEAmester is 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. Since its inception in 2016, its long-term objective is to build critical mass within the marine sciences to ensure sustained growth of human capacity, while aligning closely with the nation's research and development strategies. It aims to attract and establish a cohort of proficient marine and atmospheric science graduates who will contribute to filling the capacity needs of South African marine science. By aligning with core peer-reviewed scientific objectives through the Agulhas System Climate Array (ASCA) scientific programme, SEAmester enables students to collect data in an oceanic region of global importance and to be part of an international programme with data standards and protocols.

iAtlantic funding supported SEAmester seagoing missions in 2019, 2022 and 2023 (the gap being due to Covid), enabling seagoing training for a total of 126 South Africa students on these expeditions. Training berths were provided on board the research vessel SA *Agulhas II*, for expeditions lasting around 10 days during which time the students were trained in sampling and surveying techniques whilst collecting important oceanographic and biological data across the monitoring transect that runs across the core of the Agulhas Current off Port St Johns. Training comprises hands-on data collection on instruments such as CTD, underway measurements and autonomous devices (Argo floats, SVP drifters) and biological net tows. Training includes data analysis and instrument calibration, as well as classroom sessions on the more theoretical aspects of seagoing science.



The SEAmester 2023 cohort of students aboard SA Agulhas II, June 2023

3.4.3 JC237 Whittard Canyon cruise, August-September 2022

Expedition JC237, part of the UK's [CLASS programme](#), aimed to carry out a series of important observations to help close the knowledge gaps around the impacts of climate change and human activities in the deep sea. This expedition visited two areas that are key for this type of long-term research: the Whittard Canyon on the Celtic Margin, and the Porcupine Abyssal Plain Sustained Observatory. At both locations, the latest robotic, sensor and sampling technologies was used to characterise the faunal communities and their spatial distribution, map the bathymetry and sediment type in unprecedented detail, and capture the fine-scale characteristics of the bottom water and currents. This allowed creation of detailed habitat maps, quantification of biodiversity, and study of the environmental factors that influence biodiversity patterns. Comparing new observations with existing data provided insight into the pace and extent of changes in deep seafloor ecosystems, with the goal of being able to better determine what conservation actions need to be taken to preserve this unique environment. Joining the science team on board the RRS *James Cook* was early career researcher Lisa Skein from South Africa, who shares her experiences as an iAtlantic Fellow in Section 3.5.

3.4.4 BR10 expedition, December 2022

This expedition – at the time of writing this report the only iAtlantic mission in Brazilian waters – set out on RV *Vital de Oliveira* to investigate and explore the shelf break and upper continental slope in the Santos Basin, offshore Brazil. Executed as a collaboration between iAtlantic, Petrobras and the Brazilian Navy, the expedition team comprised a small senior leadership team and 17 early career scientists, including five iAtlantic Fellows and 12 oceanography students from iAtlantic partner universities UNIVALI, University of São Paulo, Federal University of Espírito Santo and Federal University of Santa Catarina. The team spent 17 days at sea carrying out a range of sampling activities in and around the Santos Basin. Unfortunately, the expedition plan was hampered by the breakdown of the towed camera system, but this provided a useful opportunity for the team on board to experience problem-solving and adaptation first-hand, with a new mission plan being developed and successfully executed to generate a large amount of new environmental and seafloor data.

Further details: see the [expedition blog](#) and article in [Issue #6 of the iAtlantic newsletter](#) (p6-9).



Left: The BR10 expedition team, comprising mainly early career researchers from Brazil, aboard RV Vital de Oliveira.

3.4.5 NOAA ‘Voyage to the Deep’ expedition, May-August 2022

For three months from May through to mid-August 2022, the NOAA research vessel *Okeanos Explorer* carried out an ambitious programme of deep-sea exploration in the North Atlantic Ocean, as part of NOAA Ocean Exploration’s contribution to the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign in support of the Galway Statement on Atlantic Ocean Cooperation. iAtlantic benefited from this campaign, which involved extensive seafloor mapping and ROV dives across the Mid-Atlantic Ridge and Azores Plateau. This expedition was a fully inclusive effort, with iAtlantic scientists – including ECRs – being closely involved in helping plan dive locations and sampling strategies for this expedition through video conferencing with the science team ahead of the expedition, as well as more detailed planning during the expedition itself.

Thanks to the telepresence capability on *Okeanos Explorer*, shore-based iAtlantic scientists (regardless of location) were able to directly join the exploration effort via a dedicated high-quality ROV camera livestream platform for the science community and by conference call direct to the onboard science team to help guide the dives, direct sampling activity and to assist with dive annotation and species identification.

In addition, the iAtlantic team at Okeanos/University of the Azores supported the *Okeanos Explorer* mission by providing an exploration command centre in Faial, from which they assisted with detailed dive planning and monitoring, particularly in the areas around the Azores archipelago. The team included iAtlantic Fellows, who gained invaluable experience in ROV dive logistics and annotation, despite not actually being on board the vessel itself.

This approach to enabling full and inclusive access to the seagoing research process is incredibly valuable, particularly as available berths on such missions are very limited and the commitment to 4-5 weeks at sea is often prohibitive for scientists who have family commitments or other obligations that

make extended periods of travel away from home difficult. Telepresence with ROV is an expensive operation and beyond the reach of most research expeditions, so to have this opportunity to work with NOAA during the lifetime of iAtlantic was exceptionally fortunate.

3.5 Researcher mobility

Facilitating the mobility of scientists between partner institutions for short study stays, to use specific equipment or facilities, or to undertake specific collaborative work is one of the great strengths of a multidisciplinary, multi-partner project like iAtlantic. Under normal circumstances, iAtlantic would have provided a framework for a variety of researcher exchanges between partner institutions, and attendance at a host of international conferences and workshops where networking with peers (both within the iAtlantic network and among the wider scientific community) is a highly valuable aspect of any scientist's work, but especially so for early career researchers. However, the Covid-19 pandemic had a significant impact on the ability of researchers to travel for two years or more, particularly researchers located in the South Atlantic, so this aspect of iAtlantic's capacity building ambition was scaled back considerably. However, with some careful planning, opportunities were crafted in the later stages of the project for some Fellows to undertake visits to other partner institutions. Here we offer a couple of personal accounts from researchers from the South Atlantic who were able to take up such opportunities.

3.5.1 Case study 1: iAtlantic Fellow Lisa Skein, SANBI

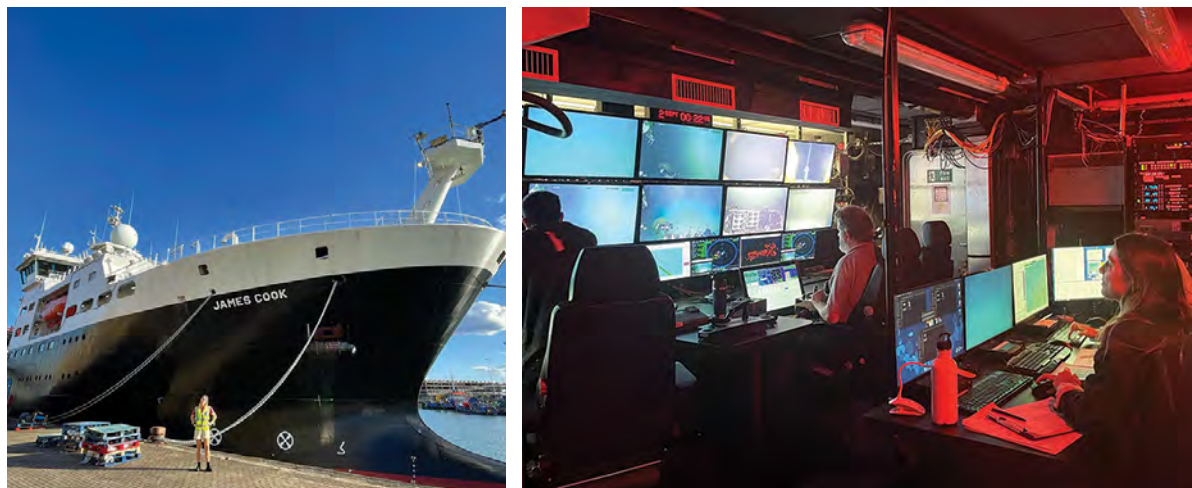
"My first introduction to the iAtlantic project was in August 2022 when I joined the JC237 expedition to the Whittard Canyon and Porcupine Abyssal Plain as a scientific volunteer. As a biologist coming from a mainly rocky shore / kelp forest background, I was extremely excited to have been given the opportunity to expand my biological knowledge to the mysterious world of the deep-sea. I distinctly remember a pre-cruise afternoon tea with cruise PI Veerle Huvenne (NOC), where she explained how the cruise is all about an interdisciplinary approach to deep-sea research, working together as opposed to working in silos. This could not be more true, and so I also managed to develop a better understanding of other processes that come into play in shaping deep-sea ecosystems from the fields of oceanography, geology, sedimentology, and seafloor topography.

A few months later, the iAtlantic project announced that funding would be made available to support a series of small projects for South Atlantic-based researchers. This came following the unfortunate cancellation of a portion of the iMirabilis2 cruise in the South Atlantic as a result of Covid-19. Shortly after, I was approached by Veerle that wanted to know if I would be interested to partake in a short-term project on Species Distribution Modelling (SDM) of deep-sea corals in the South-East Atlantic that would form part of work delivered under Work Package 2 of the iAtlantic project. Not having much (any) experience with SDM, I was eager to do the work but would need to learn from scratch. And so, in January 2023, my "SDM journey" started and over the next five months I would immerse myself in analyses with the guidance of subject expert Tabitha Pearman (NOC), Veerle, and other iAtlantic collaborators that shared data** to enable the analyses. The study focused on a cold-water coral, *Enalllopsammia rostrata*, that is regarded as a species characteristic of a Vulnerable Marine Ecosystem and forms complex habitats for a myriad of other deep-sea animals. In addition to focusing on an ecologically important species, other aspects also made this study especially valuable. It is the first study on Walvis Ridge (SE Atlantic) to generate predictive distribution maps of deep-sea animals. In addition, as is often emphasized of the South Atlantic deep-sea, it takes place in a data-limited environment, and so any first maps produced serve as valuable starting points for future studies. We were also fortunate in being able to make use of hydrodynamic variables that were developed in high-resolution by Christian Mohn (Aarhus University) and others (iAtlantic Deliverable 1.3) for a section of*

Walvis Ridge. This is not often done in predictive mapping of animals that live on the seafloor, as such high-resolution hydrodynamic information is not always readily available, although it always results in more accurate maps. I got to explore the effects of these variables on modelling outputs during an iAtlantic-funded two-week visit to the National Oceanography Centre in Southampton where Veerle, Tabitha and I processed and incorporated the hydrodynamic variables shared by Christian. During this time I also managed a short visit to Plymouth University to present some of our preliminary results to the Deep Sea Conservation Research Unit lead by Kerry Howell, where SDM is also a key research focus. During this visit, I received the news that our work had been accepted for a full talk at the recent International Symposium on Deep-Sea Corals in Edinburgh. The opportunity to present this important research on an international stage, with all its associated exposure, learning and networking opportunities, was definitely the highlight of the past five months' hard work. Over the last few weeks, I have been fortunate to continue working in the field of SDM, and bringing the work closer to "home" where South Africa is also a case-study region in the Mission Atlantic project (sister-project to iAtlantic). Annual Mobility Grants issued by Mission Atlantic to researchers and technicians working on any aspect related to Integrated Ecosystem Assessment have allowed me to extend my stay in the UK to spend more time with Kerry Howell's group at Plymouth University, where Kerry co-leads Work Package 4 of the Mission Atlantic project, focusing on improved benthic maps. In working with and expanding on what I have learnt to date, we are now performing research that will help us better predict where Vulnerable Marine Ecosystems may occur in the deep-sea of the South African EEZ. This work is still ongoing. Finally, I conclude this by expressing my immense gratitude to Veerle Huvenne, Tabitha Pearman, Kerry Howell and Kerry Sink (SANBI), all of whom have invested significant effort in my work and development as an Early Career Researcher to date, especially over the last year (and still ongoing!). I also thank EU-H2020 projects iAtlantic and Mission Atlantic for providing the funding and networking platforms that made all this a reality."

* Co-collaborators include Covadonga Orejas (IEO), Roberto Sarralde (IEO), Christian Mohn (Aarhus University), Javier Murillo (Fisheries & Oceans Canada), Irene Perez (IEO), Patricia Garcia (TSUP Proy AGSA-MAPI Baleares).

** Data underpinning analyses were collected during three interdisciplinary research cruises at Walvis Ridge off Namibia that were collaborative efforts of the Namibian and Spanish Governments, as well as local stakeholder SEAFO (South East Atlantic Fisheries Organisation).



Above, left: Lisa Skein ahead of boarding RRS James Cook for expedition JC237. Right: working in the ROV control room on board the ship.

3.5.2 Case study 2: Marcos Barros da Silva, Ifremer/UNIVALI

“iAtlantic’s work on habitat mapping (WP2) aims to investigate ecological patterns over a wide range of scales, from basin to local (<1-10 km) scales. Another important aim of iAtlantic is to standardise methodologies across the different areas of the North and South Atlantic selected for the project.

A post-doctoral position, co-financed by iAtlantic and Ifremer, was proposed for a Brazilian candidate to describe and understand the distribution of cold-water coral communities at local scale in two iAtlantic study regions where cold-water coral habitats occur: the Lampaul canyon in the Bay of Biscay (French EEZ, iAtlantic Region 2) and the Vitoria-Trinidad seamount chain in the Brazilian EEZ (Area 11).

I was selected for this 18-month position, starting in October 2022, with my time shared between Ifremer (Brest, France) and UNIVALI (Santa Catarina, Brazil). For the first part, I benefited from the acquisition of a high resolution ROV dataset during Ifremer’s [ChEReef 2021 cruise](#) which allowed me to examine the relationship between coral distribution and bathymetry (and derived variables) when available at the same resolution, and analyse the substrata.

Other activities I will carry out as part of this study include: (1) high resolution 2D or 3D reconstruction of image mosaics by photogrammetry using Ifremer’s MATISSE software, (2) annotation of coral habitats, substrate, and organisms of the megafauna using the Biigle annotation platform, (3) Extraction of quantitative variables (surface, density) using Ifremer’s 3Dmetrics software (4) Calculation of terrain variables from multibeam data at high resolution (CloudCompare software) and (5) Identification of field variables/substrates structuring the patterns of distribution of fauna (statistical analyses and/or predictive models). I was also able to participate in the Azor Drift-Cam training workshop in June 2023.

It is my intention to use the knowledge I have gained during this post-doc position to expand the skill set within the UNIVALI team when I return to Brazil. The main objective is to enable the team to carry out investigation activities, processing and analysis of high-resolution data in cold-water coral habitats, using video footage, photogrammetry and the annotation scheme of the Biigle platform as tools, as well as applying the knowledge I acquired in the Azor drift-cam workshop. Ultimately, I hope I can train colleagues in activities related to the process of mapping deep sea habitats: from image processing in the 3D model reconstruction stage, generation of point clouds and extraction of geomorphometrics from terrain variables, to eventually cataloging the species of interest on the Biigle platform.”

3.5.3 Case study 3: iAtlantic Fellow Renata Arantes, UFSC

“Capacity building initiatives between institutions across the Atlantic Ocean hold immense significance. These efforts transcend geographical boundaries, serving as crucial channels for the exchange of knowledge, expertise, and experiences. In the context of the iAtlantic project, such initiatives play a fundamental role in bridging gaps between researchers, institutions, and regions. They facilitate the sharing of diverse perspectives and innovative approaches, enhancing our collective understanding of complex ecosystems. For me, two key technical training workshops had particular value.

My institution, the University of Federal Santa Catarina (UFSC), assumed the role of host for the iAtlantic Cold-water Coral Taxonomy Workshop (October 2022) - a collaborative effort that I had the privilege of co-coordinating. Over the span of three days, we delved into hands-on activities, driven by a clear objective: to deepen our understanding on the fundamental attributes necessary for the taxonomic identification of deep-water coral groups.

The true significance of this event was amplified by the enthusiastic participation of 21 researchers representing Brazil, Europe, and Canada – all united by the shared aspiration to expand their proficiencies and exchange insights. The workshop transcended the enhancement of our technical skillsets; it became a nexus that solidified connections among researchers hailing from diverse

geographical backgrounds. This workshop exemplified the remarkable potential of cross-institutional training in fostering meaningful collaborations and shaping a unified global community of researchers.

The Azor Drift Cam Workshop held in the Azores in June 2023 went beyond the realms of theories and practical applications, immersing participants in a transformative experience. The assembly of a diverse cohort, composed of researchers hailing from various nations such as Portugal, Brazil, South Africa and Scotland, cultivated an environment ripe for the sharing of insights and experiences. These interactions extended beyond scheduled sessions, affording an informal yet invaluable platform for networking.

For me, the workshop was an inspiring interchange of experiences. Collaborating with international peers, each bringing their own distinct expertise, proved to be profoundly transformative. The innovative drift cam technology they showcased opened new horizons in the exploration of deep-sea habitats, especially in unexplored areas of the South Atlantic. In exchange, I shared my knowledge in taxonomy and organism recognition through imagery, revealing potential synergies capable of redefining the trajectories of our research endeavours. This eye-opening experience showed us just how much we can achieve when researchers from different Atlantic regions join forces. Looking ahead, I'm excited about the chance for more collaborations and even more meaningful sharing of experiences."

3.6 Technology and data transfer

iAtlantic has put significant efforts into transferring deep-sea technology and associated technical know-how to partners in the mid-Atlantic and South Atlantic regions, spanning a range of disciplines. Despite the limitations brought about by Covid on our seagoing plans in the South Atlantic, iAtlantic has assisted in significantly expanded the technical capability of the SAMBA oceanographic mooring array, as well as providing access to equipment and technologies to advance seafloor and ecosystem mapping. Further downstream in the research process, iAtlantic's data management team have worked hard to improve data archive infrastructure and access to South Atlantic datasets, supporting the development of a regional data facility that can be used and accessed by all researchers working in the region.

3.6.1 Expanding ocean monitoring capability in the South Atlantic

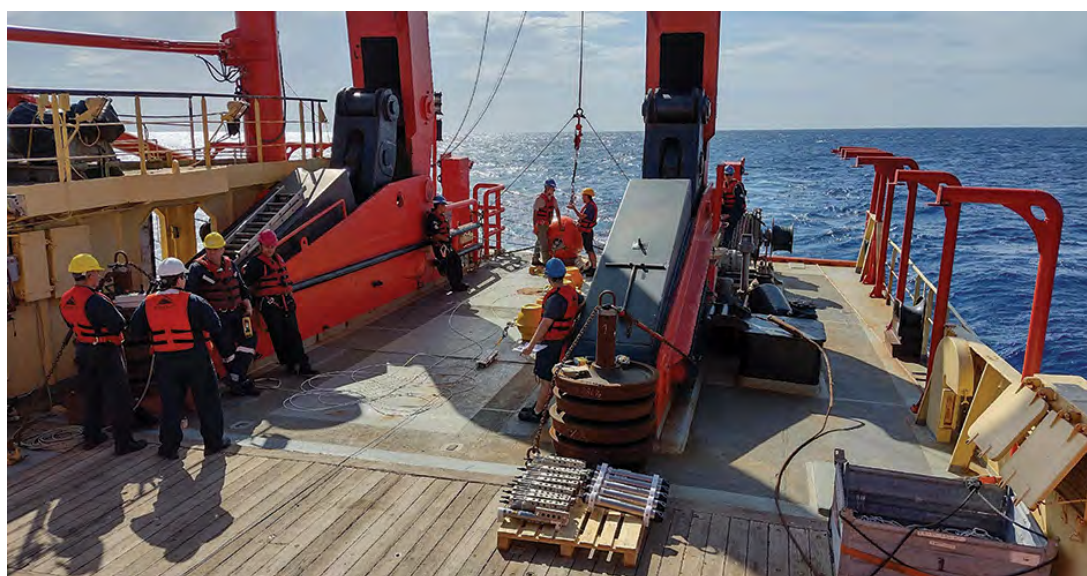
A key objective of iAtlantic was to better align ocean observing capacities in the South and North Atlantic. In the South Atlantic, the SAMBA oceanographic mooring array monitors the southern part of the Atlantic Meridional Overturning Circulation (AMOC) at 34.5°S through the long-established international SAMOC initiative (South Atlantic Meridional Overturning Circulation). However, the technical capacities of this array are limited compared to equivalent installations in the North Atlantic.

Through a collaboration with the EU-funded sister TRIATLAS, two new moorings were deployed at the westernmost part of the SAMBA/SAMOC array during an Argentine cruise aboard ARA *Austral* in December 2022. These tall moorings directly measure essential water properties throughout the water column at fixed depths, which are key to identify distinct water masses. Deployment of the new moorings was significantly delayed due to the COVID pandemic, but the moorings will be recovered after one year, in December 2023.

These new instruments were deployed in the southward flowing Brazil Current, an important component of the AMOC, along the eastern coast of southern South America. Existing measurements from the SAMOC/SAMBA-west array at 34.5°S are to a large extent performed using echosounders situated on the seafloor, but the new moorings will directly measure seawater properties throughout the water column, from the seafloor up to the surface. It is expected that these observations will reveal important

aspects of the evolution of ocean currents and ecosystems over time in a region where continuous *in situ* observations are sparse. Data from this new mooring will allow analysis of oxygen measurements in tandem with physical measurements to detect and understand combined variations of ocean currents and physical and biogeochemical water mass properties, as well as improve scientific knowledge on how these properties influence ecosystem changes, marine resources, and ocean health in the SW Atlantic. Additionally, the enhanced capacity to observe the temporal variability of oxygen concentrations in the Brazil Current is part of international efforts to enhance oxygen measurements in critical locations in the Atlantic Ocean to better track water masses, their connectivity, and related ecosystem changes.

Looking beyond the lifetime of iAtlantic, future comparisons of measurements in the Brazil Current, at the Agulhas Leakage and from the North Atlantic Current could improve our understanding of exchanges at sensitive gateways in the Atlantic Ocean.



Deploying moorings on the SAMOC-SAMBA line in the South Atlantic, December 2022. Photo courtesy Michele Baqués

3.6.2 Low-cost video mapping technology: the Azor Drift-Cam

Finding reliable, low-cost ways to survey and monitor marine ecosystems is crucial for countries that do not have access to equipment such as remotely operated vehicles or research vessels from which to deploy them. The Azor Drift-Cam developed by the team at IMAR offers an effective solution, being easy and cost-effective system that can be assembled from off-the-shelf components and deployed from a wide range of vessels. Following consultations with iAtlantic scientists in Brazilian partner institutions, project funding was reallocated to enable Universidade Federal de Espírito Santo (UFES) to purchase the components of a Drift-Cam system, with training on its assembly and operation provided through a dedicated training workshop in June 2023 (see Section 3.3.7).

Prof. Paulo Sumida, Director of the Oceanographic Institute at Universidade Sao Paulo noted that “*In my institution we lack higher tech equipment such as an ROV and a state-of-the-art research vessel. This makes this easy-to-use and cheaper equipment a perfect solution to explore the SW Atlantic deep-sea habitats*”.

Another senior Brazilian colleague commented “*As a researcher, I believe that the Azor drift-cam workshop was a milestone in my profession. Especially for the quantity and quality of the information given in it. As a researcher in northern Brazil, I intend to use this tool to improve the development of local marine research, in an attempt to insert the studies carried out there within the global scenario.*”

3.6.3 Expanding access to seafloor mapping data

The iMirabilis2 expedition to Cabo Verde focused on acquisition of high-quality seafloor mapping data, using the autonomous underwater vehicle Autosub6000 and the ROV Luso to collect detailed information about the seafloor features, habitats and ecosystems around the islands. The iMirabilis2 science team worked closely with the local government, research institutions, NGOs and conservation projects in Cabo Verde to plan the sampling campaigns. All data collected during the cruise was made fully available to the Cabo Verde authorities and local research teams to support efforts in the management and conservation of the deep-sea ecosystems of Cabo Verde, including their national marine spatial planning work. All iMirabilis2 mapping datasets are published as open access resources in PANGAEA, EMODnet (bathymetry data) and Zenodo (species catalogue of deep-sea megabenthic fauna). Support from iAtlantic scientists for further local analysis of these datasets is an ongoing activity.

3.6.4 Data management, access and visualisation

Within the iAtlantic data management team (WP7), UNIH (PANGAEA) has worked intensively with SAEON (South African Environmental Observation Network, Cape Town) to improve the FAIRness (Findability, Accessibility, Interoperability, Reusability) of South Atlantic legacy data and to enable full access through global data portals. The SAEON Open Data Platform already serves as a trusted repository for research data produced by environmental science institutions in South Africa and was therefore designated as the primary point of contact for iAtlantic data publications from the South Atlantic region.

Together with the technical developers at CNR-IA (Florence, Italy), the SAEON data catalogue system was fully integrated into the GEOSS portal, the Global Earth Observing System of Systems. The GEOSS portal is a global open data initiative and ensures a global reach, addressing the largest possible number of users and stakeholders. As with other iAtlantic trusted data repositories (e.g. PANGAEA, SEANOE), all SAEON datasets are consequently accessible through the GEOSS portal, allowing an almost complete end-to-end verification of the metadata management and publication processes. In particular, the Marine Information Management System (MIMS) datasets provided by SAEON are disseminated through the GEOSS portal. With updated protocols and successful adaptations to the data system infrastructure, the SAEON catalogue is now harvested monthly to maintain synchronisation with the GEOSS platform. The successful integration with GEOSS has enabled SAEON to assume the role of the primary research data repository for data publications from iAtlantic and its sister projects in the South Atlantic region. This is an important milestone in improving the visibility and accessibility of South Atlantic data resources, which remains a high priority for the transatlantic research community. SAEON and UNIH worked hard to attract additional data providers covering the South Atlantic region, such as iAtlantic partners UNIVALI (Brazil) and CONICET (Argentina). South Atlantic legacy data and new data submissions will be published on the SAEON Open Data Platform and made available on the GEOSS portal shortly thereafter. To increase the visibility of data publications archived in SAEON, and to provide a direct link from PANGAEA to SAEON to aggregate iAtlantic datasets generated during the same cruises, UNIH integrated a direct data link from PANGAEA to collections of relevant datasets in SAEON.

To further support the mid- to long-term technical/editorial developments and infrastructural advances of the SAEON Open Data Platform to become one of the leading research data repositories for the South Atlantic region, UNIH organised a one-day (virtual) "Lessons Learned" workshop on 22 September 2023, exclusively for SAEON technical staff, to share knowledge and practical experience gained during the past three decades of operating the World Data Center, PANGAEA. The workshop programme comprised presentations by both partners on the technical details of the data curation and publication workflows currently established in their institutions, and Q&A session hosted by UNIH to answer and discuss specific questions submitted by SAEON colleagues ahead of the workshop. The

workshop provided important support to the ongoing technical and editorial development of the SAEON data publication system through valuable knowledge transfer, and to help build local capacity to effectively continue the development process beyond the completion of iAtlantic.

3.7 iAtlantic webinar series

iAtlantic organised and hosted a regular webinar series from April 2020 onwards, comprising a blend of technical sessions offering insight to a specific research methodology or challenge as well as more general webinars where scientists presented their latest results to the wider iAtlantic community. In some cases, a series of technical sessions was convened as a follow on from initial in-person workshops at start of project; other sessions were specifically planned in response to requests from partners in the South Atlantic who identified capacity needs that could be addressed by other members of the Consortium.

In addition, the iAtlantic Fellows convened their own 'Follow the Fellows' webinars, during which they presented work in progress, often using the session as an opportunity to get feedback, support and alternative perspectives from a multidisciplinary audience.

A total of 26 iAtlantic webinars (each at least 1 hour long) were organised up to the time of writing this report, as well as numerous centrally facilitated online working meetings involving partners across the consortium. These online sessions were particularly helpful in maintaining and strengthening relationships between colleagues from different institutions during the pandemic period, when in-person meetings could not take place. However, following almost two years in which most scientists spent a large part of their working day in video conferences, the webinar series was paused to allow scientists to focus on returning to work in their laboratories. Feedback from our community indicated that making time to attend webinar sessions was becoming increasingly challenging as activities returned towards a post-pandemic normal.

All iAtlantic webinars were open for anyone to join, and the session recordings are freely available via the [webinar archive](#) on the iAtlantic website.

3.8 Collaboration with other initiatives and projects

Where opportunity has allowed, iAtlantic has collaborated with and contributed to other capacity building initiatives in the Atlantic region. Some are an integral part of the iAtlantic workplan, such as the SEAmester programme run by University of Cape Town (see Section 3.4.2); others are new initiatives stimulated by the All Atlantic community, such as the floating university concept developed by the AANChOR programme. iAtlantic worked closely with regional groups such as the WASCAL Consortium in West Africa in delivering the regional capacity building workshop for the North Atlantic (Section 3.2.1), and the COLACMAR community for regional training events in central America (Section 3.2.2). We have also collaborated with established international networks such as the Deep Ocean Stewardship Initiative (DOSI) on hosting outreach events, and a number of iAtlantic Fellows are engaged with the UN Ocean Decade Early Career Ocean Professionals (ECOPs) programme and the Deep Ocean Observing System DOERs group. A joint training event that attracted global participation was organised within the COBRA network (Section 3.3.9), and iAtlantic organised and hosted three online satellite events as part of the UN Decade of Ocean Science for Sustainable Development's thematic laboratory events in 2020-21.

Successful capacity building collaborations have also been established with All Atlantic sister projects such as TRIATLAS (for mooring deployments in the South Atlantic, Section 3.6.1), with Mission Atlantic for researcher recruitment (Section 3.5), and with the COST Action MAF World for dedicated training events such as the two iAtlantic cold-water coral workshops (Section 3.3).

4 Reflections on successes, challenges and lessons learned

Notwithstanding the significant impacts of the Covid-19 pandemic, iAtlantic's capacity building programme has delivered a wide range of learning opportunities and capacity enhancement activities in both the north and south Atlantic. The iAtlantic community has embraced the philosophy of placing capacity building at the core of its mission and has worked hard to foster a culture of professional support, positive attitude and collaborative working centred on the shared goals of the project. There are many lessons to be learned – both positive and negative – from iAtlantic's experiences, many of which have already been described in earlier sections of this report. The summary below offers reflections on different aspects of our capacity building activities, their impact and value, and suggestions for improving future endeavours.

High-level considerations

- The Belém Statement and All Atlantic Ocean Research and Innovation Alliance provide a strong framework in which to set capacity building activities. International recognition of these strategies, and of iAtlantic's role in implementing them, confers credibility and status to project activities in the South Atlantic. However, challenges remain in some fundamental aspects of the research process in South Atlantic partner countries, such as ensuring South Atlantic partner institutions are supported to manage EU research funding and associated bureaucracy, and securing permission for non-national scientists to work collaboratively on biodiversity issues in the South. Achieving the goals of these high-level statements could be better supported by changes at operational level.
- Differences in culture and bureaucratic processes between North Atlantic and South Atlantic countries are challenging: the lesson learned here is that planning of activities (particularly related to seagoing or equipment transport) must start as far in advance as possible and be monitored closely.
- Understanding research priorities, capacity gaps and training needs of scientists is critical in both North and South Atlantic countries. It is important to move away from a generalised assumption that all capacity transfer is from north to south.

Strategic considerations

- There is no 'one size fits all' approach to capacity development activities: different approaches offer different learning outcomes, and different subject areas lend themselves more readily to a specific approach than others. For example, the ocean ecosystem timeseries workshop was convened (through necessity) as an online event, which was logistically challenging but enabled far more researchers (particularly from developing countries) to participate as they did not need to travel.
- Feedback from iAtlantic's technical training workshops shows that in-person, hands-on, specialised training generates considerable tangible impact for researchers, equipping them with skills, tools and know-how that participants are able to share with peers in their home institutions. Whilst such activities might represent a more significant investment than an online or purely classroom-based exercise, they provide many additional benefits in the form of broader reach, strengthened professional networks, opportunities for future collaboration, and the novel experience of working in a different institution or facility for a short time. Planning such events does require appropriate resourcing and practical considerations may limit participation to a relatively small group, but this is compensated for by the post-workshop multiplier effect.
- Seagoing experience remains a top priority among early career marine scientists, though opportunities to join research cruises remain limited. Availability of funding to support travel costs

associated with such expeditions is often a barrier, particularly for scientists in developing countries whose research budgets are very limited. Remote participation in cruises via initiatives such as NOAA's 'Voyage to the Deep' telepresence cruise, and (at a smaller scale) iAtlantic's 'Ship-to-Shore' buddy scheme provide opportunities for land-based researchers to familiarise themselves with aspects of seagoing research. Remote participation of this manner is hugely valuable (though many would argue not a full substitute for being on the ship) but requires upgraded satellite communication facilities on the research vessel, which is often expensive and usually not a priority in an expedition budget.

- Providing training on tools and equipment that is then made available for use in South Atlantic countries is key: for example, whilst training on ROV operations would be a great learning experience for scientists, currently there are very limited opportunities to secure the use of such instrumentation in the region. Alternative technological solutions – such as the Azor drift-cam – provides a more immediate and pragmatic exchange of knowledge and skills that can be used straight away.
- Working in partnership with other relevant initiatives and projects on appropriate topics offers the opportunity to pool resources, maximise participation and visibility, and bring together a more diverse group of researchers.
- The power of peer-to-peer support and learning should not be underestimated. Within the iAtlantic Fellows community, we found that group problem-solving and skill-sharing happened organically, in part supported by the *Follow the Fellows* webinar series in which early career researchers were invited to share their research questions and ask for input or assistance from the project community. The dynamic between researchers from north and south Atlantic was often hard to discern in this case as all were equal members of a research community, seeking answers to shared research questions at a common stage in their careers.

Practical considerations

- With funding always being an issue for researchers and the environmental impact of travel being a priority concern, there are considerable benefits to aligning in-person training events with relevant international meetings to minimise travel. This approach was used to great effect on many occasions in iAtlantic.
- Where appropriate and feasible, convening workshops as hybrid (in person and online) events is an excellent way to broaden participation and reduce carbon footprint. Indeed, hybrid events are now the norm following the pandemic, with advances in video conferencing technology now offering a much improved experience – though it may not always be possible to deliver the full workshop content via a webcam (breakout group discussions and practical lab demonstrations remaining challenging!). However, careful planning is required to accommodate time zone differences for target audiences or regions. For some, particularly in the global South, reliable internet access is a challenge, so providing access to recordings of key presentations is very useful.
- Language is also an important consideration. In iAtlantic, most partners were happy to converse in English, but we were fortunate to have multilingual scientists within the partnership standing by to assist where necessary.
- Successful, long-term capacity building in terms of technology transfer needs to include training on maintenance and practical operation of equipment, not just funding to buy instrumentation.

A final word

Within a highly interdisciplinary project like iAtlantic, where project partners work closely together and share common values and goals, a huge amount of capacity development takes place on a day-to-day

basis, through joint supervision of PhD students, sharing of samples and data, and experiential learning (for example on writing up manuscripts for publication). This is often not formally recognised, being considered part of the 'business as usual' mode of international research but is at least – if not more – important than the project's formal capacity building events.

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Annex A: Document information

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Work Package	No.	6	Title	Capacity Building, Engagement, Outreach and Exploitation

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Dissemination level	x	PU Public, fully open, e.g. web		
		CO Confidential restricted under conditions set out in Model Grant Agreement		
		CI Classified, information as referred to in Commission Decision 2001/844/EC		

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