Project news

Spring 2020

iAtlantic
INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

Enhancing ocean observing capacity in the South Atlantic

In this issue...

Welcome to iAtlantic!

Participants at the iAtlantic Kickoff Meeting in June 2019 enjoy the view from Arthur's Seat, the famous rocky hill overlooking the city of Edinburgh

iAtlantic has launched one of the most ambitious attempts to study deep and open ocean ecosystems and understand how they may change in the future. But to achieve our objectives we don't focus solely on these ecosystem assessments. Over the next four years we will share and build human and technical capacities around the Atlantic and work directly with industries and regulators to bring the latest science through to ocean management and international governance.

At the end of our project we need to be able to identify which Atlantic regions are experiencing the most rapid rates of change, and which support ecosystems showing tell-tale signs that they might reach a critical point from which they cannot recover. And to achieve this we've created a plan built upon understanding the physical foundations of the Atlantic – particularly its oceanography and physical geography.

In this newsletter you can explore these foundations and learn more about how iAtlantic is working to understand the Atlantic's circulation. As well as using advanced computer simulations of this circulation, iAtlantic is working closely with our sister project Triatlas to put new instruments in the water so we have better measurements of key parameters, like the oxygen vital to marine life. This practical hands-on approach means iAtlantic is an active sea-going project that leads and partners with expeditions throughout the Atlantic. Check out examples in this newsletter from GoodHope Voyage in 2019 through to the ambitious plans for iAtlantic's flagship expedition iMirabilis scheduled for 2020.

It's fantastic to see how much work has been achieved since we launched iAtlantic in June 2019. Training courses have begun, plans for our ocean observation work completed and the seabed mapping team have got off to a truly remarkable start by mapping almost a quarter of a million square kilometres between the Cabo Verde islands in the eastern and the Caribbean in the western Atlantic (despite their magnetometer suffering some light shark damage). And work to bring iAtlantic's findings to policy has also started through our policy team's work with STRONG High Seas and workshops to support the on-going 'biodiversity beyond national jurisdiction' negotiations at the United Nations.

However, as I write this in late March 2020 the world has entered a very uncertain time. Across the globe we are working in self-imposed isolation to limit the devastating expansion of the COVID-19 pandemic. As with all aspects of human society, this has major implications for iAtlantic. We need to support each other across our project as the inevitable changes to our expedition plans, laboratory and other research work become clearer. Sadly, we will not be able to meet as planned in Cape Town in May this year, but we will do all we can to create a fun and engaging online alternative. Please stay tuned for updates and do contact the Project Office with any ideas to create the best online experience.

J Murray Roberts, iAtlantic Coordinator
Edinburgh, 27 March 2020

iAtlantic's mission

iAtlantic is a multidisciplinary research programme seeking to assess the health of deep-sea and open-ocean ecosystems across the full span of the Atlantic Ocean. Involving marine scientists from countries bordering the north and south Atlantic Ocean, this ambitious project will determine the resilience of deep-sea animals - and their habitats - to threats such as temperature rise, pollution and human activities. iAtlantic aims to deliver knowledge that is critical for responsible and sustainable management of Atlantic Ocean resources in an era of unprecedented global change.

5 main objectives

Align and standardise ocean observing in the north and south Atlantic to enable short, medium and long-term assessments of ocean circulation

Map deep and open-ocean Atlantic ecosystems at **local, regional and basin scales**

Assess the **stability, vulnerability and tipping points** of these ecosystems in relation to a range of stressors

Build and enhance **human and technological capacities** for cost-effective cooperation and planning across the Atlantic

Work with industry, regulatory and governmental stakeholders to use this knowledge in support of a **sustainable Blue Economy**

Vital statistics

Project full title: An Integrated Assessment of Atlantic Marine Ecosystems in Space and Time (iAtlantic)

Funded under the EU's All Atlantic Ocean Research Alliance Flagship (call H2020-BG-2018-2020)

33 partners from Europe, Brazil, South Africa, Argentina, Canada and the USA, complemented by a wider network of associated partners

Project duration 4 years, starting June 2019

EU funding volume of € 10.65M

Coordinated by University of Edinburgh, UK

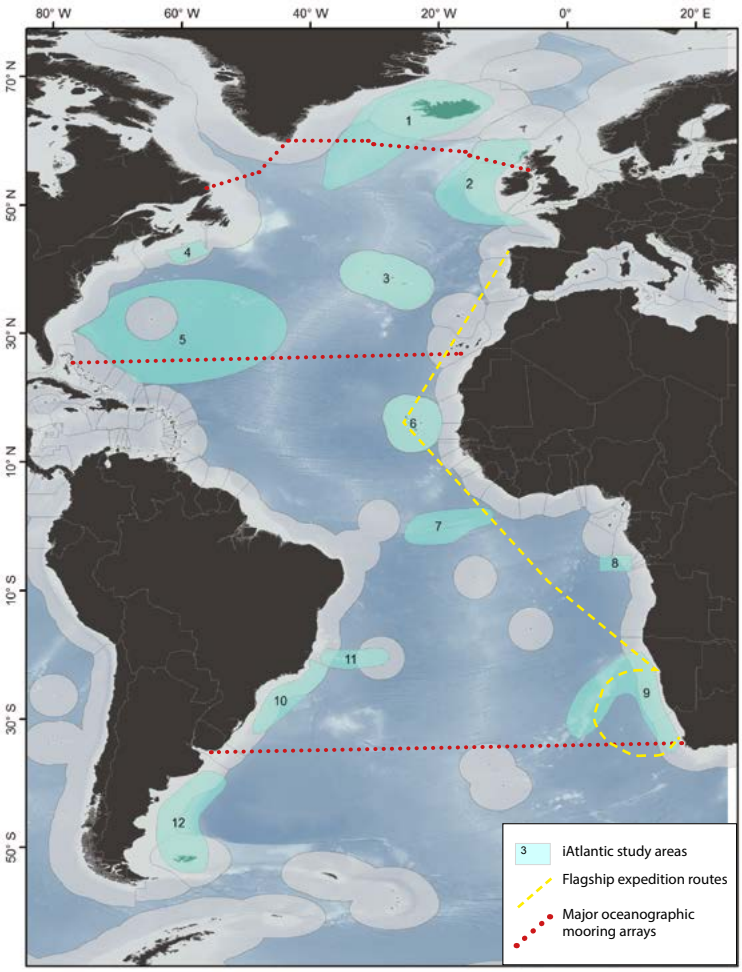
Work programme managed through the iAtlantic Steering Committee, with expert guidance and advice from an external Advisory Board and Science Council

Form more information visit www.iatlantic.eu

The iAtlantic project: A quick guide

For readers who are new to iAtlantic, here's a quick summary of what we're all about

12 key ecosystem assessment areas



The iAtlantic study areas: (1) Subpolar Mid-Atlantic Ridge (MAR) open-ocean ecosystem off Iceland; (2) Abyssal plain and deep-sea coral banks from the Rockall Trough to the Porcupine Abyssal Plain; (3) Deep-sea coral and hydrothermal vent ecosystems, central MAR; (4) Deep-sea canyons and open-ocean ecosystem, NW Atlantic; (5) Subtropical open-ocean ecosystem of the Sargasso Sea; (6) Tropical open ocean off equatorial Africa; (7) Equatorial deep/open ocean fracture zones; (8) Continental slope, margin and cold seep ecosystems - Angola to the Congo Lobe; (9) Abyssal plains and deep-sea ridge ecosystems of the Benguela Current from the Walvis Ridge to South Africa; (10) Deep-sea continental slope, banks and cold seep ecosystems off Brazil; (11) Vitória-Trindade Seamount Chain off Brazil; (12) Deep-sea coral banks in the Malvinas Upwelling Current off Argentina.

External Advisory Board

High-level experts from key sectors and background with global reach

Phil Williamson, UEA (Chair)
Wendy Brown, IOGP
Kristina Gjerde, IUCN
Alan Leonardi, NOAA
Lisa Levin, Scripps Institute
Jake Rice, DFO Emeritus
Torsten Thiele, Global Ocean Trust

Independent Science Council

Independent experts providing technical advice on specific research issues

Jake Rice, DFO Emeritus (Chair)
Paul Brett, Memorial University Newfoundland
Pierre Legendre, University of Montreal
Jacob Gonzalez-Solis, University of Barcelona
Owen Sherwood, Dalhousie University
Paul Snelgrove, Memorial University Newfoundland
Daniel Dunn, University of Queensland
Gordon Paterson, Natural History Museum UK
Rhian Waller, University of Maine

iAtlantic Who we are!

iAtlantic Partnership

33 formal project partners from academic and research organisation across the north and south Atlantic that form the delivery team for the project

Associate Partners

Industrial and academic partner organisations outside the main project consortium that support iAtlantic through resource and knowledge sharing

iAtlantic Steering Committee

Responsible for overseeing and coordinating the delivery of iAtlantic's work programme. Comprising the project coordinator, project manager, work package leaders and deputies, expedition coordinators and regional coordinators

Measuring Atlantic ocean circulation
Arne Biastoch, GEOMAR (lead)
Dider Jolivet, U. Sorbonne (deputy)

Mapping deep Atlantic ecosystems
Veerle Huvenne, NOC (lead)
Colin Devey, GEOMAR (deputy)

Project Coordinator
Murray Roberts
U. Edinburgh

Project Manager
Mila Vukomanovic
U. Edinburgh

Understanding drivers of ecosystem change
Lea-Anne Henry, U. Edinburgh (lead)
Marjolaine Matabos, Ifremer (deputy)

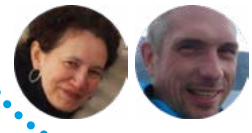
Impacts of multiple stressors on Atlantic ecosystems
Andrew Sweetman, HWU (lead)
Marina Carreiro-Silva, IMAR (deputy)

Supporting sustainable ecosystem management
Telmo Morato, IMAR (lead)
Kate Larkin, Seascape Belgium (deputy)

Sharing knowledge, building capacity
Vikki Gunn, Seascape (lead)
Sebastian Unger, TMG (deputy)

Data management
Tina Donha, UniHB (lead)
Pangaea (deputy)

Expedition coordination
Cova Orejas, IEO (lead)
Boris Dorschel, AWI (deputy)



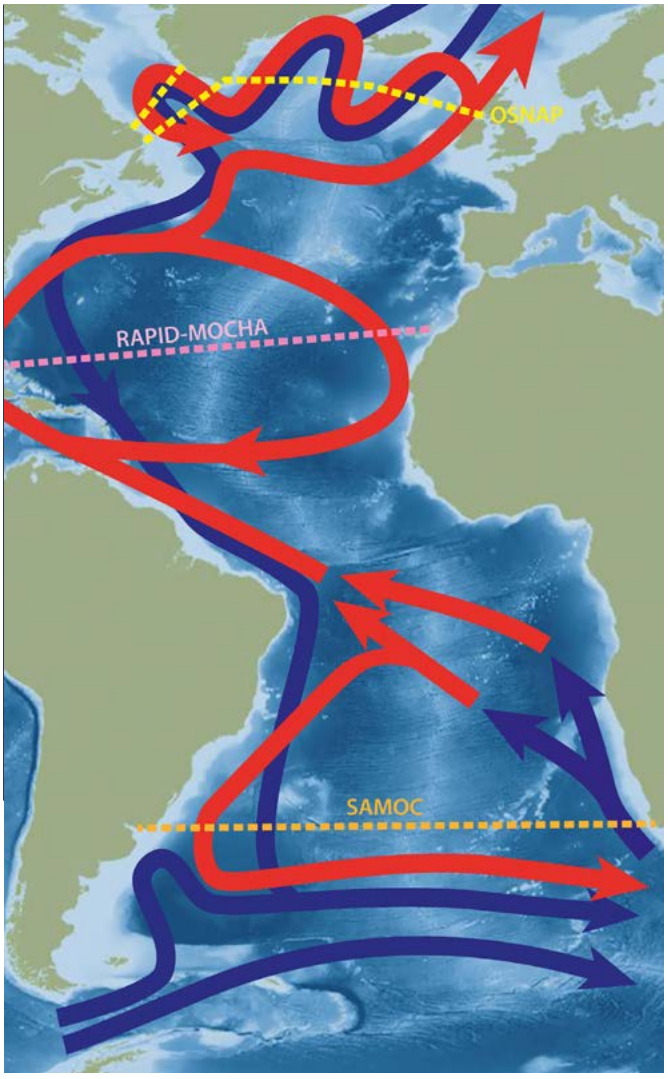
Regional coordinators
Angel Perez, UNIVALI (SW Atlantic)
AJ Smit, UWC (SE Atlantic)
Ellen Kenchington, DFO (NW Atlantic)
Stefan Ragnarsson, MFRI (NE Atlantic)

Enhancing AMOC monitoring in the North and South Atlantic

By María Paz Chidichimo[1], Stuart Cunningham[2], Alberto R. Piola[1], Isabelle Ansorge[3], Tarron Lamont[4] and Clare Johnson[2]

[1] CONICET and SHN, Argentina; [2] SAMS, Scotland; [3] UCT, South Africa; [4] DEA, South Africa

The Atlantic Meridional Overturning Circulation (AMOC) is the global conveyor belt that transports large amounts of heat, salt and carbon dioxide. Although the AMOC presents significant variability from intra-seasonal to inter-annual timescales, there is evidence to suggest that it is currently in a weaker state. By the next century, the circulation is predicted to weaken further, altering not only patterns of temperature and salinity, but also the carbonate chemistry and distribution of oxygen in the Atlantic. These changes could radically impact marine ecosystems from the base of the food chain, to the microbes and sponges and corals, to top ocean predators such as tuna and billfish.



At SAMOC/SAMBA-WEST (see map below) two new moorings are planned: one under the iAtlantic project, and the other via its sister project, TRIATLAS (see article on p15). The iAtlantic mooring will be deployed at 700 m water depth and will contain an acoustic doppler current profiler (ADCP), combined condctivity-temperature-depth (CTD) and dissolved oxygen sensors, and Aquadopp current meters. This mooring will provide the first direct time-series of the Brazil Current at the shelf break upstream of the Brazil-Malvinas Confluence. The complementary TRIATLAS mooring will be deployed at 3450 m water depth and will contain both CTDs and current meters spanning the full water column. These moorings will improve constraints on the subtropical freshwater transports, and reduce uncertainties in the basin-wide SAMOC calculation. Both moorings will be deployed in austral Spring 2020 and recovered in austral Spring 2021.

The SAMOC/SAMBA-EAST array monitors the important Agulhas Leakage from the Indian Ocean. The shedding of Agulhas Rings (eddies peeling off the Agulhas Current as it turns back on itself just south of the South African peninsula) is one of the major sources of salinity in the South Atlantic, with variability in the leakage presumably correlating with changes in strength of the AMOC. SAMOC/SAMBA-EAST consists of a number of moorings, ADCPs, and current and pressure-inverted echosounders. Within iAtlantic, dissolved oxygen sensors will be added to some of these moorings, with planned deployment in October 2020.

The OSNAP mooring array monitors the AMOC in the important subpolar North Atlantic region (see map, left). Within iAtlantic, combined CTD and dissolved oxygen sensors will be redeployed on a mooring in the eastern boundary, along with a combined CTD, dissolved oxygen and pH sensor. This mooring captures one pathway of the northward flowing upper water. The time-series data from the moored instruments will be combined with data from hydrographic sections in order to calculate transport of nutrients and carbon through the eastern boundary.

Left: The AMOC is monitored by three purpose-built arrays (dashed lines). From south to north these are the: SAMOC/SAMBA array (34.5 °S; orange dashed line), RAPID/MOCHA array (26.5 °N; pink dashed line) and OSNAP array (58 °N; yellow dashed line). One of iAtlantic's key tasks is to enhance the AMOC monitoring capacity at the SAMOC/SAMBA and OSNAP arrays. Blue and red arrows indicate major ocean circulation pathways of cool and warm water, respectively.

A. Oelofse

GoodHope voyage 2019

Expanding our understanding of South Atlantic circulation

By Isabelle Ansorge and Josh Mirkin, University of Cape Town

Schiermeier's "Ocean under Surveillance" article in *Nature* (9 May 2013, Vol 497) highlighted the need for an extensive array of continuous measurements across both the northern and southern Atlantic Ocean. The call for these observations is due to the ocean's Meridional Overturning Circulation (MOC), a global reaching system of ocean currents and the primary mechanism for the transport and storage of heat, freshwater and carbon between ocean basins. Climate models have shown that past changes in the strength of the MOC were linked to climate variations, with future predictions hinting that the MOC will continue to modulate climate change scenarios on timescales from decades to centuries. The meridional gap between Africa and Antarctica provides a significant crossroad for water mass exchange between the subtropical Indian and South Atlantic gyres. Despite its important role, the oceanic passage south of South Africa has been less studied than its two counterparts south of South America (the Drake Passage) and south of Australia.

GoodHope is a hydrographic monitoring transect between Cape Town and Antarctica, and forms a vital contribution to the iAtlantic programme in collecting underway thermal data and biological samples. Since 2004, South African students have been participating on the annual GoodHope voyages between South Africa and Antarctica, collecting thermal data in the top 1000 m of the water column. The GoodHope experiment includes high density conductivity-temperature-depth (CTD) and expendable bathythermograph (XBT) measurements between Cape Town and the Antarctic ice shelf (see map, left). Part of the GoodHope section was designed to follow the ground track of the JASON satellite array, with the aim of combining hydrographic and altimetric data analyses. In addition, Argo and sound velocity profilers (SVP) drifters are deployed during these cruises to provide year-round hydrographic information for the Atlantic Ocean south of Africa. With an increase in high resolution XBT sampling and deployment of Argo profiling floats against the backdrop of satellite altimetry for the south Atlantic,

the South African scientific community have been able to quantitatively improve their knowledge on regional ocean dynamics and how water properties are exchanged south of Africa and beyond. In particular, we have been able to characterise the regional mesoscale dynamics that continue to play a major role in zonal and meridional exchanges across the South Atlantic basin.

The austral summer 2019 expedition aboard the South African research vessel *SA Agulhas II* departed from Cape Town on 5 December 2019, heading for 6 weeks at sea under the leadership of Gerhard de Jager (University of the Free State) to continue the oceanographic measurements necessary to monitor the variability in the upper layer interocean exchanges between South Africa and Antarctica on seasonal and interannual time scales. The data collected on this expedition (and future GoodHope voyages) is available via NOAA's Atlantic Oceanographic and Meteorological Laboratory (online at www.aoml.noaa.gov/phod/hdenxbt/ax_home.php?ax=25), and will contribute to iAtlantic's efforts in understanding how changing ocean circulation might affect ecosystems in the South Atlantic region.

Five South African ocean science students joined the December 2019 GoodHope expedition. Below are some reflections from Joshua Mirkin, MSc Biogeochemistry student at the University of Cape Town.

Antarctica: a vast open wilderness. Deserted, barring the occasional penguin. The perpetual sunlight of the polar circle holds minimal warmth, yet burns any skin foolishly left exposed. This is the world to which we are headed. We awake, in Cape Town, ready to depart to this unknown world, excited about the possibilities, experiences and challenges it will force us to face. Within the first few days, we begin to settle into life aboard the *SA Agulhas II*, establishing a routine of mealtimes, research, sleeping and socialising. Aboard, we are responsible for the deployment of Expendable Bathythermographs (XBTs),

Above: The approach to the ice shelf of Antarctica is an awe-inspiring experience. Image courtesy J. Brundrit.

temperature probes which provide information on the ocean's upper 1000 m. Establishing this routine is initially challenging, but as we steadily move south and the days lengthen, we begin to settle into our new way of life for the next 6 weeks.

As we centre ourselves on the ship, we begin to engage with our fellow passengers and crew aboard the vessel. Ship-bound scientists and engineers study the vibrations experienced by the vessel as well as the birds, seals, whales and phytoplankton that surround it. The majority of the passengers, however, are here to be transported to SANAE IV, the South African base in Antarctica. The ship-based scientists tell stories of investigation, research and discovery, while the drivers, pilots, mechanics, carpenters, chefs, engineers, young professionals and scientists headed for SANAE IV tell stories of their previous adventures, of life in its most extreme and survival in the most isolated and hostile environments imaginable.

Our previous experiences feel so tame and sheltered in comparison, yet here we are, hopelessly inexperienced, heading to one of the most remote, inhospitable regions on earth. On our journey, we experience wild weather, resulting in unparalleled nausea and yet we still venture outdoors to

Above: Students get involved in deploying equipment such as surface drifters (left) and the weather balloons (right). Images courtesy J. Brundrit.

deploy XBTs, being sprayed by seawater and battered by wind in the process. We begin to adapt quickly to our new wild, isolated existence.

Life once we reach the ice continent is one of chaos and splendour. The logistical challenge of maintaining and operating an Antarctic base becomes immediately apparent, while the sheer majesty of the towering ice that surrounds us is overwhelming. We once again begin to adjust to a new way of life, a life where we work, eat and sleep at a time determined arbitrarily by our watches rather than the sun. The challenge of surviving in such a hostile environment becomes painfully obvious, even from the luxury of the *SA Agulhas II*, where all our physical needs are catered for.

Life in Antarctica is one of discovery and sacrifice. While pushing oneself further than one ever thought imaginable, one must let go of that which we have left behind. While our friends, family and loved ones still remain landbound, we sail away from them, off into a sea of self-discovery and personal growth.

Christmas and New Year passed while by the ice; events, conventionally celebrated with our closest family and friends, are celebrated with the new family beginning to form on the vessel. For Christmas, we ventured out onto the sea ice where we encountered inquisitive Adelie penguins, allowing us to develop a deep appreciation and respect for this incredible, dynamic ice system as well as the life that makes it their home. Near the beginning of the New Year, we made landfall at South Georgia, a previous whaling station and the final resting place of Sir Ernest Shackleton. Here we encountered territorial seals, which now rule the island, and were able to hike within the mountains present on this majestic island.

Our brief moments off the *SA Agulhas II* allowed us to truly appreciate what we have missed about life on land, and the luxuries and comforts of the vessel. On land, we felt connected to the earth, the plants, the stability and majesty of towering mountains and the life which hauls itself out onto its beaches. This reminds us of our deep need to be in an environment with some element of stability. It also allows us to reflect on life at sea, where we come to appreciate the family that has formed aboard, the beauty and discovery within a perpetually changing environment and an appreciation for the true awe-inspiring power possessed by the ocean, wind and ice.

This journey into the Southern Ocean is one not only of science, physical exploration and experiencing different environments, it is one of personal discovery, growth and community formation. Life aboard the vessel is not easy, but I would not trade the life-changing experiences gained on this journey for anything.

RV SA Agulhas II *approaching the Antarctic ice. Image courtesy J. Brundrit.*

South Atlantic Gateway (SAGA) project

New instrumentation in the South Atlantic to measure zonal flow

By Pedro Vélez Belchí [1], Alonso Hernández-Guerra [2] and Josep Lluis Pelegrí [3]

[1] Instituto Español de Oceanografia, Tenerife; [2] Instituto de Oceanografía y Cambio Global, Universidad de Las Palmas de Gran Canaria; [3] Consejo Superior de Investigaciones Cientificas, Institut de Ciències del Mar, Barcelona

The South Atlantic Ocean forms a major component of the climate system, among others, since it regulates the intensity of the Atlantic Meridional Overturning Circulation (AMOC). Although most of the AMOC flows meridionally (i.e., along the longitudinal lines of the Atlantic) there is an important zonal (latitudinal) component at the surface[1], intermediate and deep levels[2]. However, there are not enough observations to quantify its role in the AMOC.

In the framework of the new South Atlantic Gateway (SAGA) project funded by the Spanish Research Agency during 2020 and 2021, the University of Las Palmas de Gran Canaria (ULPGC), together with the Spanish National Research Council (CSIC) in Barcelona, the Spanish Oceanographic Institute (IEO) and the Center for Scientific Research and Higher Education in México (CICESE), will conduct a large-scale experiment to quantify the importance of the zonal flows for the AMOC in the Southern Atlantic. IEO's participation in SAGA and the use of its instrumentation in the experiment is supported by - and will contribute to - iAtlantic.

The experiment will take place in the so-called SAGA region, where both the eastward-flowing North Atlantic deep waters and the westward-flowing Benguela Current and Agulhas Rings intersect. This area has been identified as a gateway for both the starting and returning arms of the AMOC.

The fieldwork will include: two WOCE-type transoceanic cruises at 34.5°S and 9°W during the autumn of 2020 and winter of 2021 (see map below, black and blue dots), comprising 120 and 104 hydrographic stations respectively. The monitoring of zonal flows in the interior ocean will be carried out with the SAGA array. This array will include:

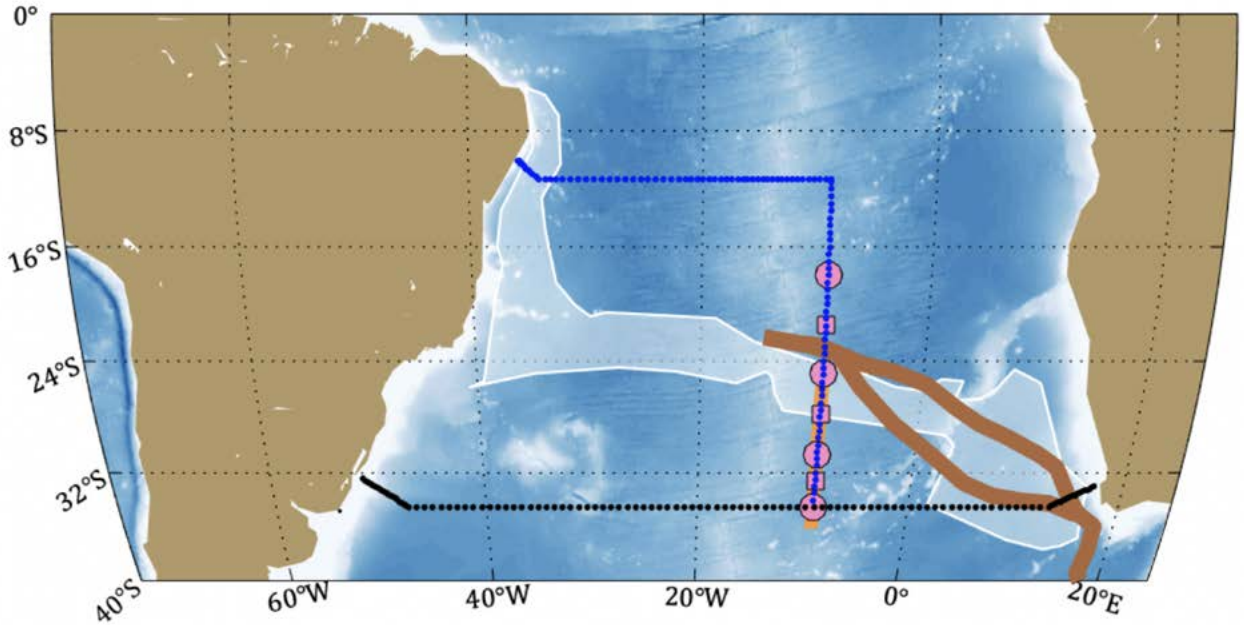
- Three tall moorings (lower 2000 m of the water column) to be installed in April 2020 until January 2021 at 9°W, between 20°S and 30°S, to monitor the barotropic component;
- Four pressure-inverted echosounders (PIES), deployed in January 2021 at 9°W, between 20°S and 34.5°S. The PIES will monitor the baroclinic component over 4 years.

For more information please visit: https://uoc-csic.ulpgc.es/project/saga-south-atlantic-gateway-global-conveyor-belt

References

[1] van Sebille, E., W. E. Johns, and L. M. Beal (2012), Does the vorticity flux from Agulhas rings control the zonal pathway of NADW across the South Atlantic? J. Geophys. Res., 117(C5).

[2] Arhan, M., H. Mercier, and Y.-H. Park (2003), On the deep water circulation of the eastern South Atlantic Ocean, Deep Sea Res. Part I, 50(7), 889–916.



Above: The thick brown line is the pathway of the North Atlantic Deep Waters, as estimated by Arhan et al (2003), the blue-white shape is the surface connectivity as estimated by Van Sebille et al (2012). The dots and squares comprise the SAGA array, including 4 PIES (circles) and three moorings (squares). The black dots are the CTD stations in the 34.5°S SAGA expedition (Capetown , 14 October 2020 – Ushuaia, 20 November 2020) cruise; the blue dots are the CTD stations in the 9°W SAGA expedition (Ushuaia, 8 January 2021 – Recife, 23 February 2021).

C. Devey

Gone mapping

RV *Maria S. Merian* maps a quarter of a million square kilometres of the equatorial Atlantic seafloor

By Colin Devey and Anne-Cathrin Wölfl, GEOMAR

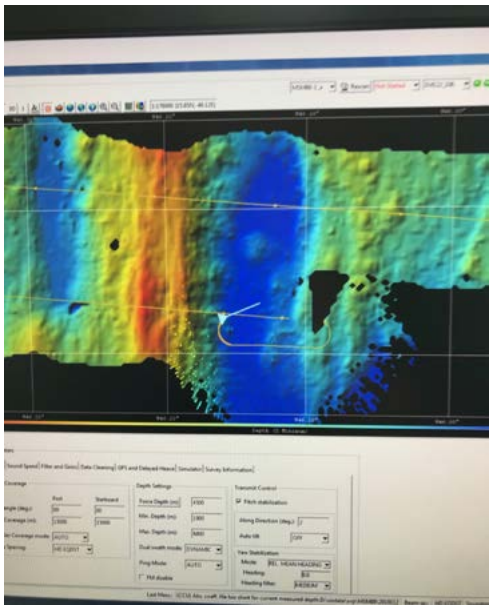
iAtlantic´s goal of producing a habitat description of the whole Atlantic relies on seafloor maps as one of its foundations: the shape and constitution of the seafloor is an important factor in determining the types of life it harbours and how ocean water moves over it. Amazingly (and we say this time and time again) less than 20% of the seafloor has been directly mapped at any resolution whatsoever; the topography (or "bathymetry") of the remaining 80% is estimated from its gravitational effect on the sea surface, but those estimates can be wildly inacccurate. iAtlantic therefore has its work cut out to achieve its goal, and any bit of mapping helps.

For this reason we were delighted when an opportunity arose to use a German research vessel to map some of the unknown Atlantic seafloor. iAtlantic partners Anne-Cathrin Wölfl and Colin Devey (GEOMAR, Kiel) spent over six weeks in December 2019 and January 2020 using the German research vessel RV *Maria S. Merian* to make a bathymetric map of the tropical Atlantic seafloor between the territorial waters of the Cape Verde islands and the Caribbean. This is one of the least mapped areas of the Atlantic and was 99% unmapped before the expedition, so choosing which route to follow and where to map was both easy and difficult!

Going to sea purely to map the seafloor was a new experience for all the cruise participants - mapping is usually one of the "fall back" activities on a ship packed with other scientists wanting to collect samples or make other observations (any idea why so little seafloor is already mapped?!). A ship that normally carries 23-24 scientists felt quite empty during the first days of the expedition, and the six-hour shifts watching the data coming in from the multibeam echosounder and post-processing data collected the previous day could get lonely in the small hours of the morning. But after the first turn (we mapped on E-W profiles, each over 1000 nautical miles long and taking days to complete) things started to heat up, as structures seen on the first profile either continued or died out on the second. As usual, the "I can´t quite see all of it" problem turned up time and again - it doesn't matter how much you have mapped, another line would be even better!

During the mapping we also towed a magnetometer behind the ship to collect data to help better visualise the seafloor we were surveying. Although the ocean from the surface appeared devoid of larger life, with the exception of a few flying fish, that appearance is deceptive. Our weekly inspections of the magnetometer regularly revealed traces of shark attacks (the strong magnetic field the magnetometer on occasions produces is thought to attract them), eventually leading to them breaking down. Not unusual for magnetic measurements, but a sign of life just under the waves.

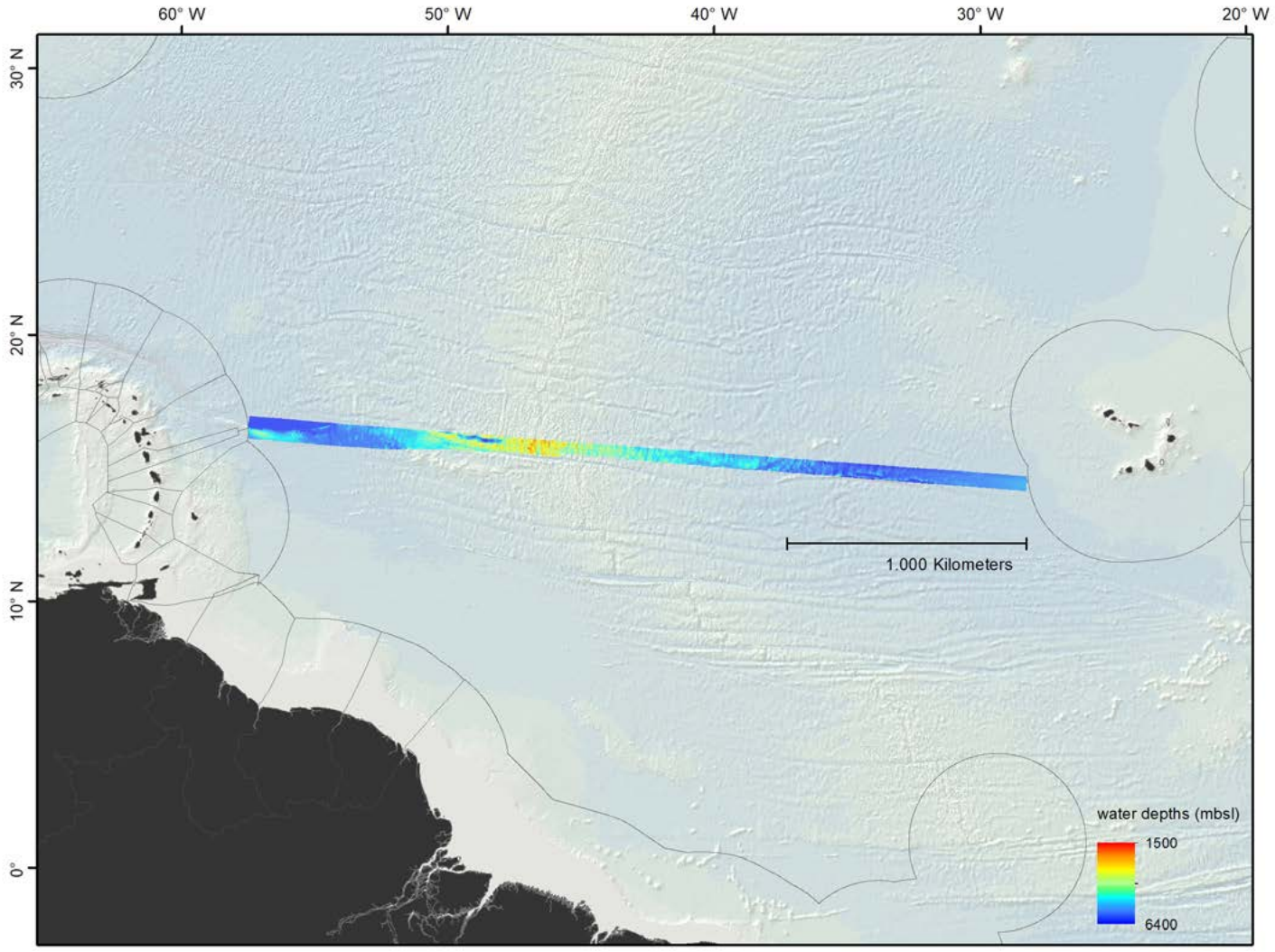
The team's efforts yielded spectacular results: in the end, the small teams of scientists on board surveyed a 60 km wide and 3100 km long transect across the Atlantic, covering almost a quarter of a million square kilometers (see below). This is just over 2% of all the unmapped area in the North Atlantic now done! The resulting seafloor map shows a myriad of seafloor forms and will provide an invaluable basis for *in situ* examinations of the habitats which it hosts.



Far left: Shark attack! The magnetometer bears the scars of some speculative nibbling from local ocean residents. Image courtesy C. Devey.

Near left: Bathymetric data appearing on screen aboard RV Maria S. Merian*, revealing the topography and structure of the Atlantic seafloor. Image courtesy C. Devey.*

Below: Once the data jigsaw was complete, the full survey map covers an area of almost 250,000 square kilometres of the Atlantic seafloor between the Cape Verde islands in the east and the Caribbean in the west. Image courtesy GEOMAR.



The iMirabilis expedition

An epic 3-month odyssey through the Atlantic!

In the boreal summer of 2021 iAtlantic will conduct an ambitious scientific expedition spanning a large part of the Atlantic Ocean. The iMirabilis cruise, named after the long-lived *Welwitschia mirabilis* plant of western Africa, is one of iAtlantic's flagship capacity-building expeditions. The cruise will take place on the Spanish Research Vessel *Sarmiento de Gamboa* (SdG; pictured below), operated by UTM (CSIC), starting in Vigo, Spain in July and finishing in Cape Town, South Africa in October 2021. This expedition was originally planned for the summer of 2020, but due the global coronavirus pandemic has been postponed to 2021. iAtlantic extends its sincere thanks to the Spanish authorities for making this postponement possible.

iMirabilis will take place in two legs: Leg 1 in Cape Verde waters, followed by a transit south eastwards for Leg 2 which will focus on the Walvis Ridge region offshore Namibia and South Africa. The transits between port calls will be used for a range of capacity-building activities, including training on the use of remotely operated vehicle (ROV) technology, multibeam bathymetry surveying, and marine wildlife observation.

The expedition is fully international with participants from South Africa, Cape Verde, Brazil, Portugal, Spain, Germany, United Kingdom and Italy. The field activities planned span a range of disciplines and will contribute data to all aspects of iAtlantic's workplan. State-of-the-art seabed survey equipment such as the autonomous underwater vehicle (AUV) Autosub6000 and the ROV *Luso* will be deployed to explore and investigate the characteristics of the remote deep-sea ecosystems and seafloor features that have never been scientifically explored before. This advanced technology will allow us to investigate benthic ecosystems in great detail, producing large volumes of high-quality imagery that will be automatically processed using new machine learning approaches. These outputs will contribute towards the high-resolution habitat maps for areas in the South Atlantic where environmental information is scarce or non-existent. The water column will also be investigated through meansurement of physical properties and zooplankton sampling.

Above: RV Sarmiento de Gamboa. Image courtesy UTM/CSIC

The ROV *Luso*, operated by a team from EMEPC, will collect biological specimens for taxonomic analysis, as well as samples for dating. New technologies will be tested, including the eDNA 'MAPS' sampler recently developed by researchers from National Oceanography Centre in the UK. Seabed lander equipment will also be deployed during iMirabilis to obtain *in situ* information on environmental parameters and demersal deep-sea fish. *Ex situ* experimental work will also take place on the ship, including short-term aquaria experiments with specimens collected with the ROV and incubations of sediment cores, collected by multicore and dredges.

iMirabilis is more than a pure research expedition, with its training and capacity building activities making it more of a "floating school". Cruise participants will include young researchers from Cape Verde who will be trained in seabird identification and seabird census techniques, as well as students from South Africa who will be trained in the use of the multibeam bathymetric surveying and use of the ROV technology. In addition, early career researchers on board will have the opportunity to shadow the principal scientists to learn the important responsibilities of leading a multidisciplinary cruise like iMirabilis - skills that can often only be learned through experience!

The port calls present an ideal opportunity to engage with local communities in Cape Verde, Namibia and South Africa, and a range of outreach and engagement activities are being planned for these short stops in between the different legs of the cruise. For those not lucky enough to be aboard the ship, the expedition's activities will be reported back via a cruise blog and (technology permitting) interactive sessions with the team on board. For more details, please keep an eye on the iAtlantic website, www.iatlantic.eu.

iMirabilis is coordinated and led by Cova Orejas at the Spanish Institute of Oceanpgraohy (IEO), with support from Andrew Sweetman (Heriot Watt University) in Leg 1, and Veerle Huvenne (National Oceanography Centre) in Leg 2. Capacity building activities are led by Antonio Calado (EMEPC; ROV training), Jacob González-Solís (University of Barcelona; seabird observing) and Simon Dreutter (Alfred Wegener Institute; multibeam bathymetry), and contributed to by the many other iAtlantic scientists on board the ship during this epic 13-week expedition!

Sentinels of the deep

By Tom Grove [1] and Andrew Stevenson [2]

[1] University of Edinburgh; [2] Whales Bermuda

Humpback mother and calf, Bermuda. Image courtesy Andrew Stevenson

Great whales are ecosystem sentinels. As they feed at several trophic levels and travel across entire ocean basins, whales can indicate wider environmental change across the Atlantic. In iAtlantic, we will focus on humpback whales in particular. With breeding and feeding grounds throughout the ocean, humpbacks are the best-characterised baleen whale and the easiest to study. As a charismatic marine mammal watched by thousands of people every year, they are also the subject of intense public interest.

As part of iAtlantic's work on invesrtigating ecological change over time, we will assess spatial and temporal trends in humpback whale abundance at several key locations. By relating these trends to physical and biological parameters, we aim to examine the potential environmental drivers of this observed variability. Understanding past trends will allow us to consider the potential impacts of future oceanographic changes on humpback whale populations.

Iceland represents a key feeding ground for North Atlantic humpback whales, with large increases in abundance reported since 1995. Using transect survey data provided by the Icelandic Marine and Freshwater Research Institute (North Atlantic Sightings Survey programme), we will assess variability in sightings from 1987 to 2015. In feeding grounds, the abundance and distribution of humpbacks are generally determined by the distribution of their prey – krill and small fish. Therefore, changes in factors that determine prey distribution – such as temperature, salinity, current speed and the plankton biomass – may explain past changes in humpback populations. We will collaborate with iAtlantic's oceanographic modelling teams, incorporating their physical models of past ocean changes into our assessments. With luck, we can project future changes in humpback whales around Icelandic waters.

In contrast, Bermuda is a key stopover for migrating humpback whales moving between their Caribbean feeding grounds and northern feeding grounds. Andrew Stevenson (Whales Bermuda; pictured in action below) has been collecting humpback whale data since 2007 and uses photo-identification of tail flukes to recognise individual animals. In total, Andrew has identified over 1600 individual whales. In iAtlantic, we will make use of this dataset to estimate changes in humpback abundance over time. Capture-recapture methods use the pattern of sightings and re-sightings of identified animals across years to calculate the number of whales visiting Bermuda in any given year. We will examine trends in estimates from 2005 to 2017 and relate these to large-scale environmental changes. Humpback whales sighted in Bermuda have been observed in all major feeding and breeding grounds, making this site ideal for assessing population-level trends across the North Atlantic.

Below: Humpback field research in action. Image courtesy A. Stevenson.

BUILDING AN ALL ATLANTIC OCEAN COMMUNITY

Implementing the Belém Statement

iAtlantic is part of a cluster of Horizon 2020 research projects funded by the European Union to further the implementation of the South Atlantic Research and Innovation flagship initiative and the Belém Statement, signed by the European Union, Brazil and South Africa in 2017 to upscale research and innovation cooperation within the Atlantic basin, from Antarctica to the Arctic. These projects are part of the All Atlantic Ocean Research Alliance, supported by the All Atlantic Ocean Initiative via the Coordination nd Support action project, AANCHoR - for more details see www.allatlanticocean.org.

iAtlantic has a number of 'sister' projects, some of which have been underway for several months and others that are just getting started. All these projects have synergies with each other, and will work closely to maximise resources and research outputs. Here is an introduction to two of these sister projects: AquaVitae and TRIATLAS, and a forward look at some of the new projects poised to join the All Atlantic community later this year.

AquaVitae: Developing sustainable aquaculture in the Atlantic Ocean

Low-trophic species, such as macro algae, sea urchins and sea cucumbers are the centre of attention in the AquaVitae project. A project consortium spread across the Atlantic, with 36 partners from 16 different countries, will look at new and more sustainable ways of farming these low-trophic species. They will then analyse the value chains, from farm to fork, seeking new hatchery protocols or market potential.

Partnerships between researchers and businesses will support the development of the following value chains:

- Macroalgae, including offshore cultivation and new species;
- Integrated Multi-Trophic Aquaculture (IMTA) – Sea-based, land-based and biofloc;
- Echinoderms, including sea cucumber cultivation and sea urchin roe enhancement;
- Shellfish, including oysters and offshore mussel production;
- Arapaima, flounder and pirarucu – cultivation of some of the most important finfish in the Brazilian market.

Above: AquaVitae Coordinator Philip James, from NOFIMA in Norway. Image courtesy Emil Bremnes, NOFIMA.

The close collaboration between research and industry partners spread around the borders of the Atlantic Ocean will facilitate the implementation of the innovations developed in the project, as well as providing access to experience-based knowledge.

AquaVitae will also work on cross-cutting activities of importance to aquaculture production, such as the development of biosensors and solutions for the Internet of Things (IoT), environmental monitoring and analysis of sustainability, value chains, market potential, and policy framework.

AquaVitae started in June 2019, and will run for four years.

For more information: aquavitaeproject.eu

AquaVitae

TRIATLAS: Tropical and South Atlantic climate-based marine ecosystem predictions for sustainable management

Just like its sister projects, TRIATLAS also focuses on the Atlantic Ocean and is part of a coordinated effort to fill the gaps in our understanding of its ecology, biodiversity, climate impacts and the sustainable exploitation of its natural resources.

The TRIATLAS project acronym comes from the long title: Tropical and South Atlantic climate-based marine ecosystem predictions for sustainable management. Its overall objective and plan is to assess the status of the South and Tropical Atlantic marine ecosystem and develop a framework for predicting its future changes, from months to decades, and thus to contribute to the sustainable management of human activities in the Atlantic Ocean as a whole.

A total of 33 institutions from Africa, Europe, and South America specialised in climate change, oceanography and social sciences as well as local stakeholders form the diverse TRIATLAS consortium to achieve this ambitious goal.

TRIATLAS has 6 specific objectives that are organised under 4 Core Themes (CTs) and 13 Work Packages (WPs). These specific goals are:

1. Enhance knowledge of the present state and seasonal dynamics of the marine ecosystem across several trophic levels, through scientifically integrating and extending the physical and biological observing system in key areas of the South and Tropical Atlantic.
2. Quantify the drivers at interannual to decadal time scale in the marine ecosystems by using observations and numerical (earth system, ocean, and marine ecosystem) model simulations to examine the interactions between different stressors (climate, fisheries, pollution) and the role of cumulative impacts on ecosystem functioning and associated ecosystem services.
3. Combine climate prediction and ecosystem models to improve forecasting capabilities of physical stressors, tipping points, recovery and changes in ecosystem state of the South and Tropical Atlantic from months to decades.
4. Contribute to improving the sustainable exploitation of Atlantic marine resources by developing scenarios combining climate-based ecosystem predictions with Shared Socioeconomic Pathways (SSP), by conducting socio-economic vulnerability assessments, with stakeholder engagement and by analysing new fisheries value chains.
5. Enhance capacity in marine ecosystems, oceanography, and climate research in the region, so as to increase the ability for managing human activities and sustainable development.
6. Ensure that activities are carried out in close cooperation and alignment with relevant programs to contribute to upscale cooperation along and across the Atlantic Ocean.

In this light, we look forward to collaborating with iAtlantic and AquaVitae, together with the upcoming sister projects funded under the follow-up call. We foresee a fruitful ground for collaboration especially on capacity development - be that observational, modelling or human - between our TRIATLAS and iAtlantic projects.

New H2020 projects joining the All Atlantic research community

SO-CHIC: Southern Ocean Carbon and Heat Impact on Climate. The overall objective of SO-CHIC is to understand and quantify variability of heat and carbon budgets in the Southern Ocean through an investigation of the key processes controlling exchanges between the atmosphere, ocean and sea ice using a combination of observational and modelling approaches. Dedicated observation, existing decades-long time-series and state-of-the-art modelling will be used to address specific objectives on key processes, as well as their impact and feedback on the large-scale atmosphere-ocean system. SO-CHIC started in November 2019 and will run for 4 years. For more information see www. sochic-h2020.eu

Subject to successfully concluding contract negotiations with the EC, we also look forward to welcoming the Mission Atlantic and Atlantic-ECO projects to the All Atlantic community in the near future.

Out and about

A round-up of the latest meetings, workshops, conferences and events

iAtlantic features at the EC's All Atlantic Research Forum

Brussels, 6-7 February 2020

The All-Atlantic Ocean Research Forum: From Pole to Pole, convened by the European Commission to showcase Atlantic research results and solutions for citizens and communities from Antarctica to the Arctic, took place in Brussels on 6-7 February 2020. Among the projects on parade were iAtlantic and its predecessor, ATLAS.

The event aimed to highlight the international cooperation stimulated by the Galway and Belém Statements, and to plan further implementation actions – including a vision of how international cooperation can be strengthened to seize the opportunities and address common challenges facing the Atlantic Ocean and the communities that depend on it.

The conference opened with inspirational speeches reflecting the insights and knowledge of the latest scientific assessments of the state of the Atlantic Ocean. The European Commissioner for Innovation, Research, Culture, Education and Youth, Mariya Gabriel, highlighted iAtlantic as one of the key projects contributing new knowledge to underpin improved and sustainable management of the Atlantic's natural resources.

Opening presentations were followed by three thematic sessions focused on i) A climate-resilient Atlantic Ocean; ii) A living and diverse Atlantic Ocean, and iii) Unveiling the resources of the Atlantic Ocean. Among the projects featured within these sessions, Prof. Murray Roberts (below) presented results from the ATLAS project (www.eu-atlas.org), and demonstrated how iAtlantic will build on the knowledge gained in order to take forward our scientific understanding of Atlantic ecosystems to develop a risk-based approach for sustainably managing human activities in the ocean.

A number of iAtlantic partners were present in Brussels, including colleagues from the South Atlantic, who also participated in various thematic workshop events convened by the AANChOR project the day prior to the Forum.

More information: allatlanticoceanresearch.eu

iAtlantic capacity building workshop focuses on harnessing the power of ocean modelling

Kiel, 21-22 January 2020

A key part of iAtlantic's work is gaining better understanding of Atlantic Ocean circulation, how this might change over time, and what impact any change would have on deep- and open-ocean ecosystems. To do this, scientists use a combination of ocean measurements, ocean models and specialist computer modelling techniques.

On 21-22 January 2020, the iAtlantic training workshop on "OGCM Analyses and Lagrangian Modelling Techniques" took place at the GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany. Fourteen participants from a range of disciplines and backgrounds, from observational and modelling physical oceanography to biology, were taught by modelling specialist Arne Biastoch and his team about how to analyse data from Atlantic ocean models. Arne leads iAtlantic's work package on measuring Atlantic ocean circulation, so is perfectly placed to guide other researchers in the project on how oceanographic modelling can help tackle some of the more ecosystem-focused research questions that are being investigated in iAtlantic.

Ocean General Circulation Models (OGCM) are used to predict the 3D evolution of ocean currents and patterns of temperature and salinity, over the full depth of the ocean across the globe. These model outputs can be used to examine potential future changes in oceanographic conditions in particular areas of the ocean in response to factors such as climate change.

Within iAtlantic, GEOMAR provides output from its high-resolution ocean models, VIKING and INALT, to support a number of the project's key tasks: i) for the analysis of ocean current variability, ii) to provide boundary conditions for the ultra-high-resolution ocean models of iAtlantic's study regions such as the planned Walvis Ridge model developed to support the iMirabilis expedition later this year, or iii) for regional and basin-wide studies of how larvae spread around the ocean. This training workshop aimed at building capacity within the iAtlantic team to broaden expertise and maximise the use of model data in a range of project activities.

One specialist technique used in understanding ocean dynamics is Lagrangian modelling, which enables us to look at how particles move around the ocean. This is particularly important for understanding what impact changing ocean circulation will have on the dispersal of larvae, and therefore on the connectivity and genetic health of particular ecosystems, such as corals or hydrothermal vent species.

With data and example programming scripts hosted on a central platform, workshop participants were trained on their specific scientific settings and undertook scientific analyses using the high-end model data provided. Individual workflows and analysis strategies were discussed, marking the start of enhanced collaboration within the different research groups in iAtlantic.

Below: Participants at the OGCM workshop in Kiel

iAtlantic at the STRONG High Seas workshop 'Science for Solutions'

Cape Town, June 2019

The STRONG High Seas (Strengthening Regional Ocean Governance for the High Seas) project seeks to build knowledge and capacity, facilitate cooperation and coordination, improve cross-sectoral management approaches and develop options for ocean governance in a new global agreement for Areas Beyond National Jurisdiction (ABNJ) in an effort to boost actions for the conservation of marine biodiversity. This five year project (2017 to 2022) is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the International Climate Initiative (IKI).

Increased coordination and collaboration amongst scientists and stakeholders is urgently needed to tackle the complex challenges facing ABNJ covering more than half of the world's ocean and harboring valuable biodiversity. These areas are subject to intensifying pressures from human activities, while the existing ocean governance framework is insufficient to stop the loss of important marine biodiversity. To address this gap, formal negotiations to create a legally binding instrument for the conservation and sustainable use of marine biodiversity in ABNJ are ongoing under the United Nations (UN). In addition to an indispensable strong global agreement, effective governance of ABNJ requires well-coordinated and well-informed action – including at the regional level.

In June 2019 in Cape Town, South Africa, Albertus Smit (University of the Western Cape) presented the recently launched iAtlantic project at the workshop 'Science for Solutions', co-hosted by the STRONG High Seas project. The workshop brought together a diverse group of stakeholders to discuss how to improve ocean planning and governance in ABNJ of the Southeast Atlantic and Western Indian Ocean.

STRONG High Seas also supports delegates of the Abidjan Convention member States through a capacity building program to participate at the UN negotiations, including the upcoming fourth round in spring 2020. Project researchers also carry out scientific work in the Southeast Atlantic region on the legal and institutional framework and the ecological and socio-economic importance of ABNJ. In addition, subsequent workshops are planned to continue to bring together stakeholders from governments, private sector, science and civil society on the topic of regional governance.

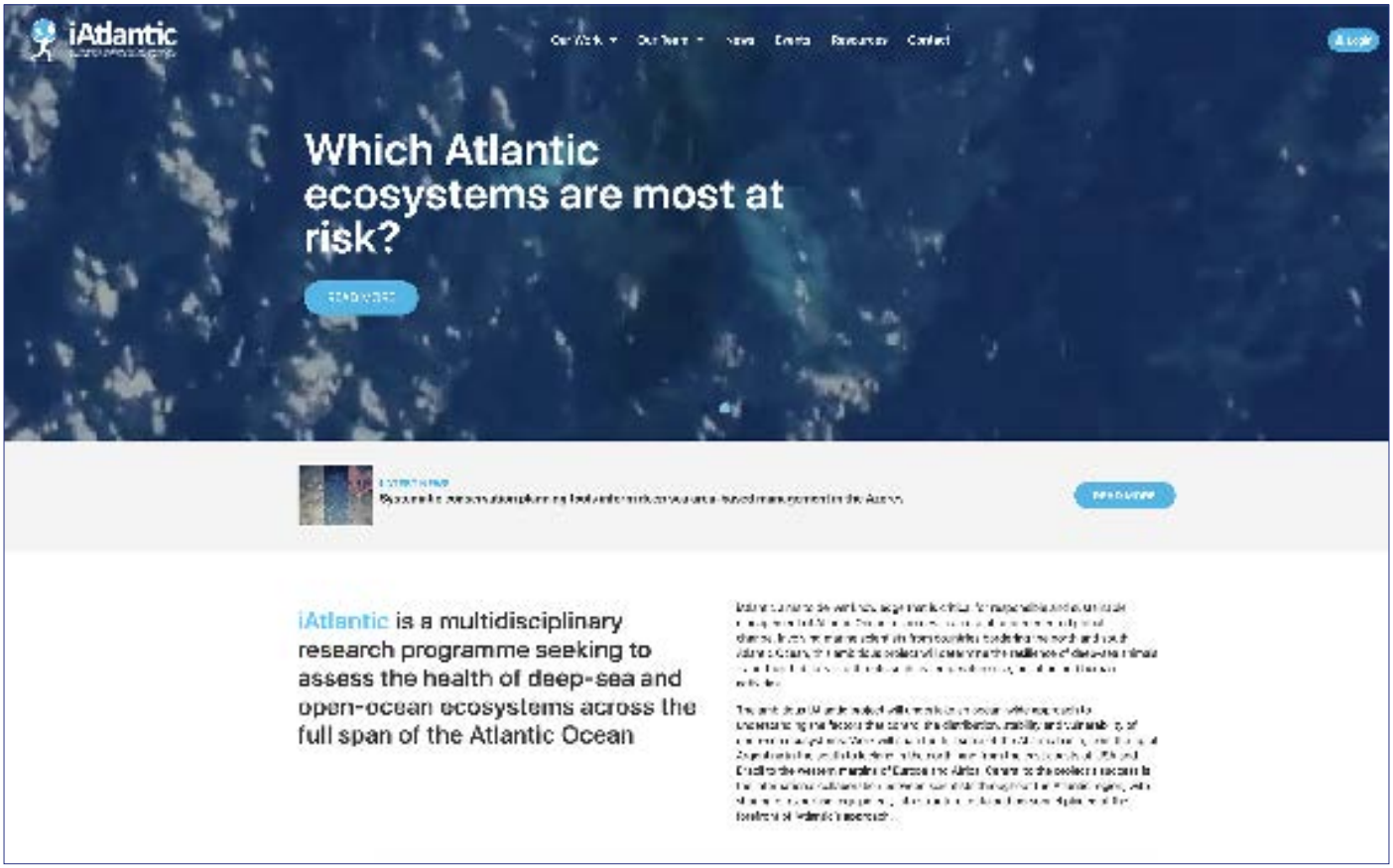
Above: Zacharie Sohou (CRHOB-CBRST) asking a question at the workshop. Image courtesy Mathias Greiner.

For more information on STRONG High Seas, please visit www.prog-ocean.org/our-work/strong-high-seas.

Towards a package: Marine biodiversity beyond national jurisdiction

Royal Society of Edinburgh, 22-23 January 2020

iAtlantic co-sponsored this high-level workshop for State delegates, marine scientists and industry experts, who are involved in the ongoing process to negotiate an international legally binding instrument for the conservation and sustainable use of marine biodiversity beyond national jurisdiction (BBNJ). The workshop aimed to facilitate an open, creative and practical dialogue between a variety of stakeholder groups. The objective of the workshop was to explore the scope of opinions that exist around key issues of the BBNJ negotiations, the reasons underpinning the differing views, and areas of divergence which require further consideration. Each session began with two short presentations, followed by a moderated discussion session on thematic topics, including marine genetic resources and access and benefit sharing, capacity building and transfer of marine technology, environmental and strategic impact assessments and enhancing stakeholder engagement. The workshop hosted 35 delegates from around the world, and resulted in two discussion summaries that can act as an aid to delegations for the next BBNJ negotiating session in New York in 2020.



iAtlantic website gets an upgrade

We are pleased to announce that the new iAtlantic website is now up and running, with a new range of content and resources available to users. The site now includes a comprehensive desciption of the work that the project will carry out, as well as an expeditions catalogue, a summary of the main 12 study regions and access to project resources, as well as a news feed and links to our social media accounts.

The site now also includes a password-protected area for project partners and committeee members to access project and meeting information, as well as resources for project presentations.

Please take a moment to go online and explore the new site: www.iatlantic.eu

Have you got news for us?

If so, we'd love to hear from you! News for the iAtlantic website, longer articles for the project newsletter, which is published twice a year, announcement of events, or simply a message via our social media accounts - are contributions all welcome! Please contact us at i-Atlantic@ed.ac.uk

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iAtlantic
INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME