Project news

Winter 2020-21

iAtlantic
INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

Finding opportunity among the challenges

In this issue...

Message from Murray

Well, what a year it's been. Truly a year like no other. A year of planning, replanning, adjusting, rebalancing and then replanning once again. And for a transdisciplinary deep-sea and open ocean project like iAtlantic, the implications of a global pandemic with all the ramifications on travel, meetings, scientific conferences and offshore expeditions have been immense.

As I write this, I am so proud of the response of the iAtlantic community to these massive challenges. Despite all the uncertainties and spiralling workloads, everyone has done a remarkable job to adapt and adjust. Think back to early 2020: we were busy planning our General Assembly in Cape Town, preliminary trips had been completed and a venue selected. Our online General Assembly felt like a novelty - we're all a lot more used to Zoom webinars now than perhaps we ever wanted to be.

This newsletter gives you a real insight into the spirit and ambition of the iAtlantic community. There are so many examples of the positive can-do spirit that's allowing us to adapt and adjust to the delays that COVID-19 restrictions have thrown at us. Following our online General Assembly we agreed to request that iAtlantic be extended by six months to help us deal with the delays. Given that there's no more funding, we know this brings issues but it's the best compromise we can make. We've also strengthened our team and are welcoming Senckenberg-am-Mer and the University of Barcelona to the core consortium. I loved watching the livestreamed ROV video from Senckenberg's IceAGE3 expedition in the summer of 2020, and we'll work hard to get more livestreaming from our 2021 expeditions - stay tuned for updates.

We have a lot to look forward to in 2021. In January we see the start of the United Nations Decade of Ocean Science for Sustainable Development, and in November Glasgow here in Scotland will host the vitally important UN Climate Conference COP 26. We want to see iAtlantic contributing strongly to both, following through on our plans to take the best science into these global policy processes.

Although 2020 has been such a tough year for everyone, this newsletter is full of hope and optimism. I'm convinced iAtlantic can weather the stormy seas ahead for two fundamental reasons – the diversity of our project, and the energy and drive of our community. If you need evidence, just read the articles in this newsletter from our early career researchers. Look at the passion of Timm Schoening and his team, with an average age of less than 30, who pulled together the Metal-ML expedition with less than 7 months' notice.

If you don't already, do follow the iAtlantic Fellows webinar series (look under "Events" on www.iatlantic.eu), and keep the Project Office up to date with your news. Thanks for all your efforts and support with iAtlantic - it's hugely appreciated. Here's to 2021!

J Murray Roberts
iAtlantic Coordinator
Edinburgh, 16 December 2020

Braving the shave!

iAtlantic's Prof. Andrew Sweetman has raised a significant sum of money for the charity Macmillan Cancer Support by agreeing to have his head completely shaved. Andrew, who received support from friends, family and colleagues, raised £1600 - far exceeding his original target of £400.

"This year has been extremely challenging for everyone around the world due to the ongoing pandemic, but for many people in my life and others around the world who are suffering from cancer, things have been even tougher" Andrew explained. "By 'Braving the Shave' I tried to help and do what I could for cancer support to help those going through similar struggles. I'm very grateful to all who have donated and provided support for this challenge. I guess there were more people out there than I thought who were interested seeing what I might look like at 60!"

For those who don't know Andrew, he normally has a full head of blonde hair!

The Metal-ML expedition: opportunities, learning curves... and a rescue mission

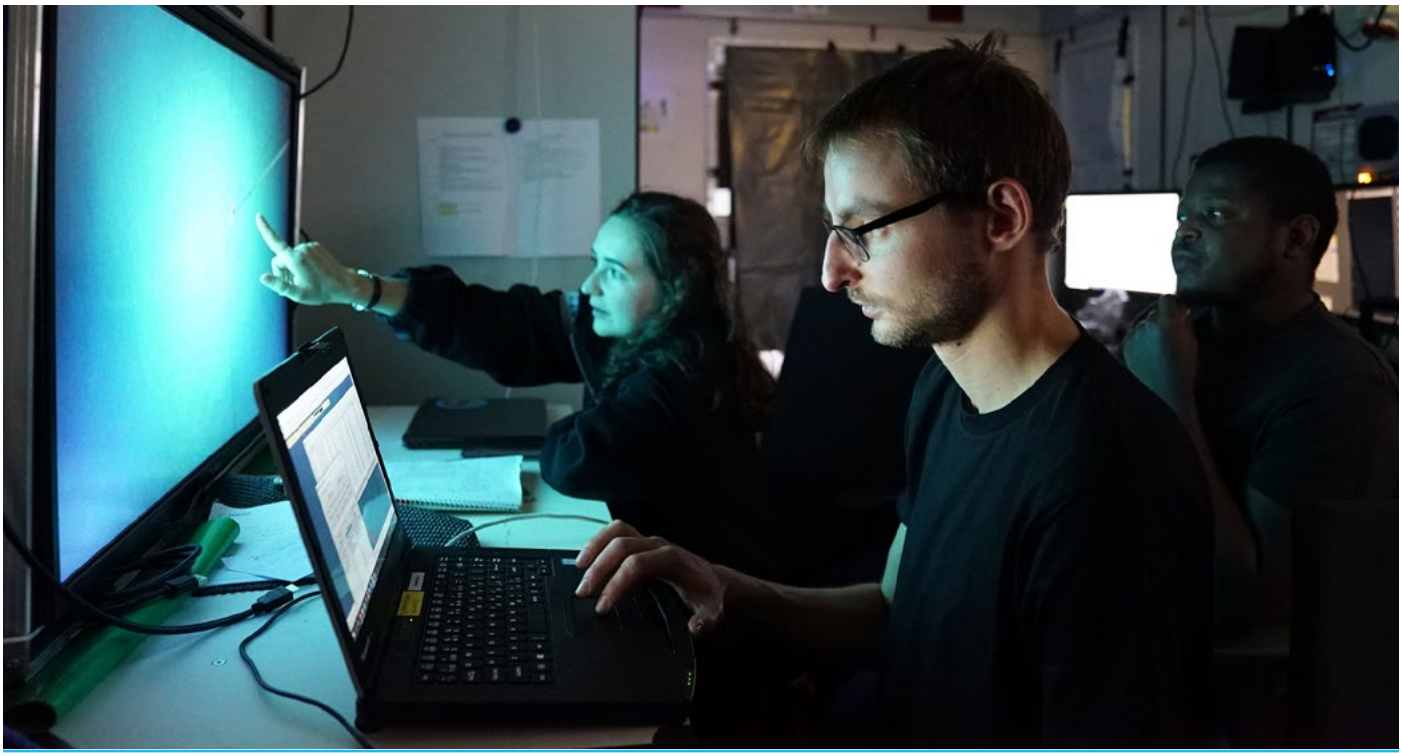
By Timm Schoening, GEOMAR

Successful marine research at sea requires planning but has also always relied on opportunities, improvisation and collaboration. How this can look in reality is the story behind cruise MSM96 and its young team of PIs and scientists on board and on shore. Together, we drafted, proposed, celebrated, planned, organised, conducted and concluded this 30-day cruise on a major research vessel within just seven months and under special circumstances.

The year 2020 is obviously dominated by negative effects of the global pandemic. On top of its many devastating impacts on humanity it is also jeopardising project goals and research progress. Its duration has already exceeded more than a few short-term contracts and postponed the hiring of early career researchers (ECR) due to budget cancellations or shifts. In Germany, a substantial number of ECR contracts are connected to shiptime, much of which has similarly been cancelled or postponed, leaving careers on hold or at a premature end. This will have a lasting impact on the future availability of young researchers in marine sciences as some bright minds will be nudged towards picking a more reliable career path in the future.

But the pandemic has also created new opportunities – and one of them is the sudden availability of shiptime due to all the cancelled or postponed research cruises. The German research vessel coordination office decided to recall all vessels to Germany in March. Since then, almost all research cruises have been altered, research programmes merged, ships been reassigned, but marine research has continued nonetheless! The amount of improvisation and collaboration needed to keep this machinery going – which usually operates on a planning and preparation cycle of years – is astounding. Despite these efforts, some shiptime still remained unallocated. Thus, a call for proposals was released at the end of April, with some rather special conditions attached: Start and end in Emden, Germany; quarantine and COVID test before departure; research area only outside of EEZs; participation only of German residents; a maximum of 13 scientists on board; a maximum of 30 days of shiptime; no requirement for large research equipment, and the feasibility to conduct the research plan year-round.

After reading this, I was excited. These conditions were a perfect fit to address aspects of the broad question that drives my research, as it is at the core of my curiosity about the oceans: what is the natural variability of processes in the deep ocean? Of course, this question is too big and unspecific to be answered in a single researcher's lifetime. Spatial variability or temporal variability? At millimetre-scale or basin-scale? Within seconds or millennia? Geological



processes? Biological processes? Geochemical processes? All of them are exciting to me, and the benefit of my niche in marine sciences is that I do not have to choose. My tools are imaging and machine learning, and these provide my vantage point onto all aspects of the question. With these tools and the opportunity provided by the call for shiptime, I set out to find colleagues to develop a specific, manageable and exciting science case to propose.

The obvious partners were colleagues from GEOMAR, AWI, Senckenberg and Jacobs University, especially their many ECRs, because of their flexibility and potential interest in shaping a cruise plan together. Emails were sent back and forth between junior researchers of these institutes who knew each other from previous cruises, research projects and conferences. We discussed litter distribution on the seafloor, technical specifications of sediment profiling camera systems, suggestions for known and unexplored research areas, researcher contract durations and much more. Already at this stage, the idea-shaping, planning and coordination was done solely by fixed-term ECRs rather than group leads or professors – not because we enforced it, but because it worked. Some ideas could not be taken forward because the group did not have access to the necessary equipment. Other ideas could not be realised because we couldn't find the people to conduct the work at sea. Indeed, the personnel challenge turned out to become the biggest planning headache. But, in the end we devised a plan: we proposed to cross the North-East Atlantic on a transect across the basin from the English Channel out to the Mid-Atlantic Rise. On the way we would conduct a spatially and methodologically hierarchical surveying and sampling scheme. Multibeam mapping, high-resolution imaging and sediment sampling would provide information on common geochemical measures, as well as rare earth element concentrations in relation to minimum topographic features of the abyssal seafloor. Aside from the core research, we also positioned the cruise in the context of ongoing German marine digitalisation projects to harness all the possible data from cruises – even though no dedicated scientists were on board – and to QA/QC the data according to standards for immediate FAIR and open publication after the cruise.

We were delighted about the reviews we received in August, stating that the "*… planned research is innovative, timely, and original, and is therefore of high scientific merit*." And that the "*project represents a major advancement in filling our gap of knowledge*". The reviews also stated that we were "*a relatively early-career team" with "decent amounts of experience operating on research vessels*", that our "*… combined expertise most certainly covers the scope of the proposed work*" and that an "*… additional positive aspect of this proposal is the support of highly qualified early career researchers*".

This was an important lesson for us. Based on our few years in the marine sciences, based on the several months we have already spent at sea, based on our network of ECRs – even if they could not participate this time – we were able to devise a state-of-the-art research plan that outcompeted proposals of renowned senior scientists.

Now the main challenge for us was to put the plan into action, and fast. To our slight surprise, we had been awarded with the very first free slot in the cruise plan. Exactly 54 days from the approval until we would set foot in the quarantine hotel. In the meantime, we had to find the final participants, hire students, charter transports, organise customs, order consumables, pack equipment and prepare ourselves. The usual administration before cruises is familiar to many of us. We lost participants because we could not finalise contracts for them in time. We received support from uninvolved colleagues, probably eased by their relative flexibility this year. We relied on the existing infrastructure of our institutes. We learned how to shift budgets, create administrative shortcuts and we met new colleagues on the way that might prove essential in developing future projects.

Another aspect of being the first cruise of the pandemic cruise plan was that we had essentially lost our gamble. It meant that we would head out into the North Atlantic Ocean in mid-October, not the ideal time to be out there to conduct research. It meant we had to expect off-time, improvise work plans and likely shifts of ship-time that was dedicated to sampling to surveying. Still, the weather is hardly predictable, and our cruise plan was flexible enough to change work areas if needed. Also, the overall research question is big enough to slightly alter the focus of the cruise if needed – so we were not too worried.

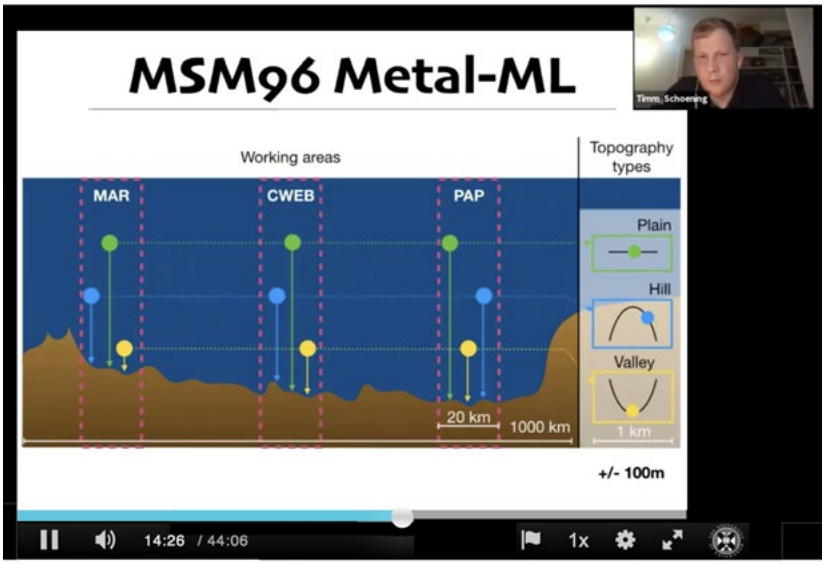
On 10 October 2020 we, a team of 13 scientists – excluding our magician / technician – had an average age below 30: three postdocs, six PhD students, three Bachelor / Master students from AWI, GEOMAR, Jacobs and Bremen University. We embarked on RV *Maria S Merian* and sailed to the first planned work area, then experienced severe weather and changed our plans massively, but in the end surveyed and sampled successfully. We discovered unexpected things that have already resulted in new research projects. The details of our at-sea experiences are documented in detail in the cruise blog: www.oceanblogs.org/msm96/

Exactly one month later we arrived back in Emden, having each secured an important piece of our research career jigsaws: for some it was their first time at sea, and they cannot wait to go back. For some it was much-needed field data to complement their PhD projects. For some it was a field experience to turn lab knowledge into reality, and for others it was obtaining crucial data that already constitutes pillars of new project proposals and career next steps. For me it was a new level of responsibility for an entire science party, their well-being, their science agenda and the pressure of having been provided with a major research vessel for a whole month and the associated anticipation of fulfilling our proposal promises.

To do so, we are now distributing the digital data for immediate FAIR and open publication, processing the sediment and water samples in the lab and finishing the administrative tasks after the cruise. Again, all that is only possible in collaboration with our colleagues who provided the essential support to make a cruise successful. The lessons we learned are that we can devise, organise and conduct state-of-the-art marine research, but that we are very much dependent on our international network of colleagues to do so. Their help in shaping ideas, rejecting nonsense, providing tools, methods and paperwork made our idea of exploiting this opportunity a reality. It also allowed us to conduct an international research mission within days, with diplomatic clearance provided through official and unofficial channels within hours!

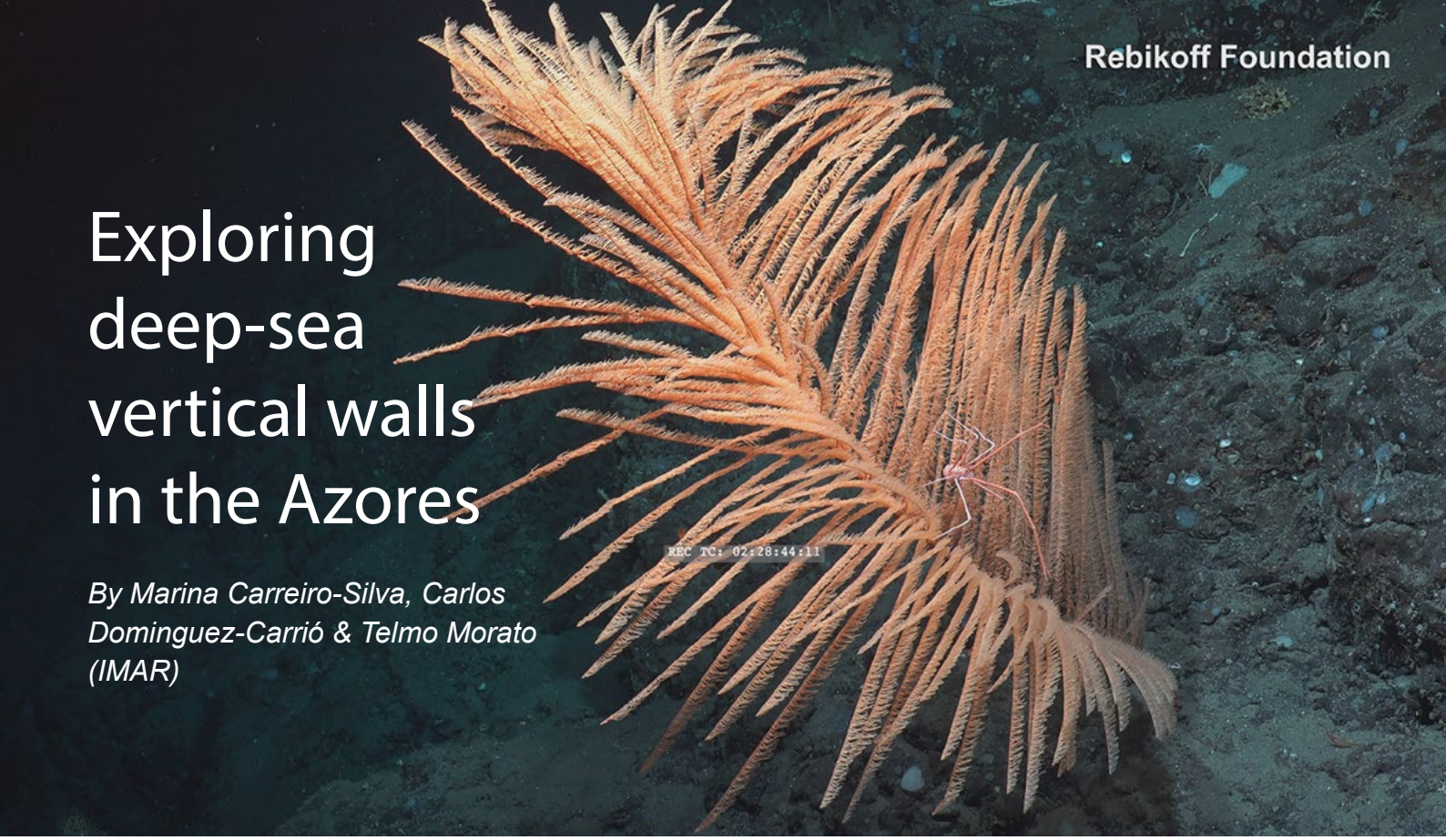
What we do not have as ECRs is access to personnel and this was our main challenge. Senior researchers and group leaders can naturally mobilise more people, we could only invite them and hope their superiors allow them to participate. In our case, it was our supervisors' and mentors' concession to us to invite their PhD students to our cruise. Without their trust in us we would not have been able to conduct MSM96 and would never have tried in the beginning.

This time we had to improvise a lot on the spot, but strengthened and initiated collaborations along the way. I cannot wait to organise the next expedition because so much more remains to be done to answer my research question. But next time without COVID restrictions please.



Timm kindly shared his experiences on MSM96, along with some perspectives on the wisdom of taking opportunities as an early career researcher, in a recent iAtlantic *Follow the Fellows* webinar.

If you missed it, you can watch on demand via the webinar archive at www.iatlantic.eu/events-calendar/iatlantic-webinar-archive/



Exploring deep-sea vertical walls in the Azores

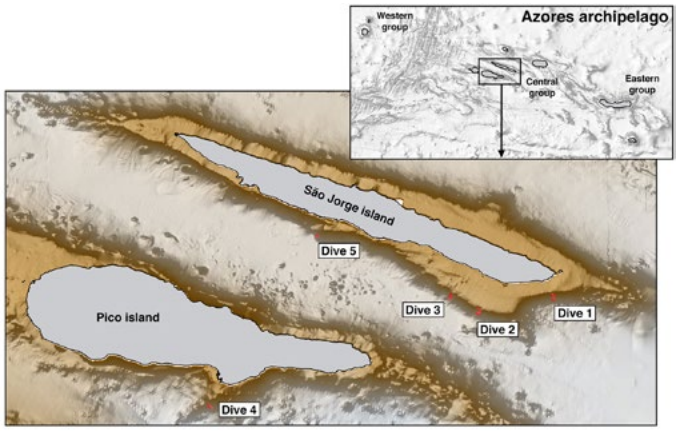
By Marina Carreiro-Silva, Carlos Dominguez-Carrió & Telmo Morato (IMAR)

Sitting in the middle of the Atlantic Ocean, halfway between the American and the European continents, the Azores region harbours a diverse seafloor topography that includes seamounts, ridges and island slopes. Its complex seabed landscape generates a multitude of different habitats that are home to several deep-sea benthic communities, including cold-water coral gardens and sponge aggregations.

Under the umbrella of iAtlantic's work on habitat mapping, the Institute of Marine Research at the University of the Azores (IMAR-UAz) will characterise and map the deep-sea benthic communities that dwell in the different geomorphological features of the Azores deep sea, most of which have never been explored until now. This task will be mostly accomplished using a custom-made low-cost underwater camera system developed at IMAR-UAz during the past three years. This imaging system can survey extensive areas of the seafloor after being deployed from small vessels, including fishing boats. Like an ROV, the area that this system can explore is relatively large, but it becomes difficult to operate in areas of high relief, such as vertical walls associated with the steep morphology of seamounts and island slopes. In these cases, manned submersibles, which are not connected to a surface support ship via an umbilical cable and hence cannot become entangled in complex reliefs, offer an alternative method better suited to study benthic communities found on very steep terrains and rock overhangs.

The DeepWalls and iAtlantic projects took advantage of the submersible LULA1000 operated by the Rebikoff-Niggeler Foundation (www.rebikoff.org) to document and map the benthic communities associated with deep-sea vertical walls down to 1000 m depth, which are otherwise very difficult to study. IMAR-UAz researchers Marina Carreiro-Silva, Telmo Morato and Carlos Dominguez-Carrió participated in five submersible dives during July and August 2020, in which the steep slopes of São Jorge and Pico Islands were surveyed (see map below).

The island of São Jorge, with its odd oblong shape resembling an ancient marine creature, was thoroughly explored with LULA1000 by means of four different dives along its southern coast. This part of the island is characterised by sharp cliffs that continue underwater, becoming some of the steepest walls recorded in the whole Azores archipelago. Diving with LULA1000 on these walls was a truly remarkable experience, and provided an opportunity to observe some of the most diverse black coral assemblages known to date in the Azores, mostly at depths of 800-1000 m. Such assemblages, formed by centuries to millennia-old species, have been previously documented at seamounts through historical records and fishing by-catch, but they are rarely encountered in present times. Looking through the dome-shaped window of LULA1000, we felt as we were scuba diving amongst the large 1-2 m tall black coral colonies and its associated small

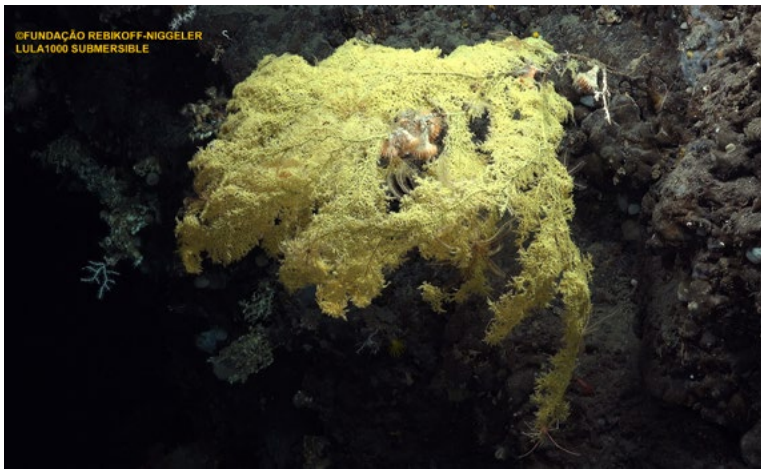


critters, such as crabs, anemones, molluscs, hydrozoans and small fishes. In the southern slopes of Pico island, where one more LULA1000 dive was performed, the vertical walls were also home to dense black coral populations. Interestingly, these black corals harbored the eggs of deep-sea sharks amongst their branches, highlighting the importance of these ecosystems not only as refuge and feeding areas for associated fauna, but also as potential nurseries for rare or sensitive species.

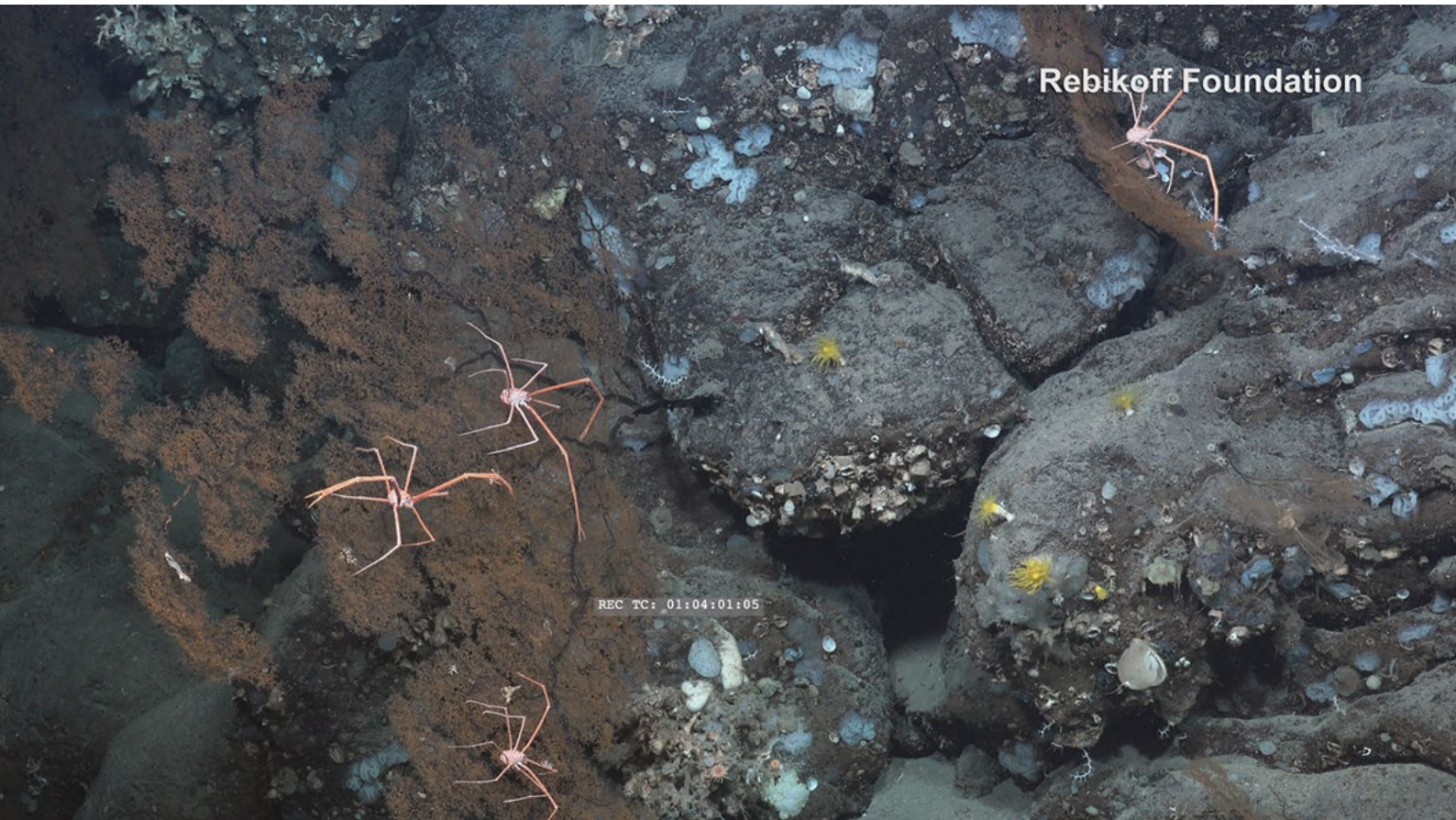
We expect that the high-quality video footage and photographs collected at the survey sites will contribute to better understand the species composition, ecological associations and functional roles of these benthic communities. Additionally, in the framework of the EU's Marine Strategy Framework Directive, we aim to evaluate the environmental status of the communities observed on vertical walls and their potential to be used as reference sites in the Azores, generating new knowledge to better define Good Environmental Status (GES) in deep-sea benthic communities. Data gathered in these surveys will be instrumental in informing the responsible and sustainable management of Atlantic Ocean deep marine ecosystems in an era of global change.

DeepWalls (Exploring pristine deep-sea walls to establish baselines for Good Environmental Status in the Azores - ACORES-01-0145-FEDER-000124) is a research project funded by the Operational Program for the Azores 2020 (PO Azores 2020), aims to map and document the occurrence of vulnerable marine ecosystems associated with vertical deep walls in the Azores and suggest baseline conditions in the context of GES.

Rebikoff-Niggeler Foundation (FRN) is a non-for-profit organization for marine research that aims to facilitate research and in situ observation and documentation of deep-sea environments by means of manned submersible technology (LULA1000).



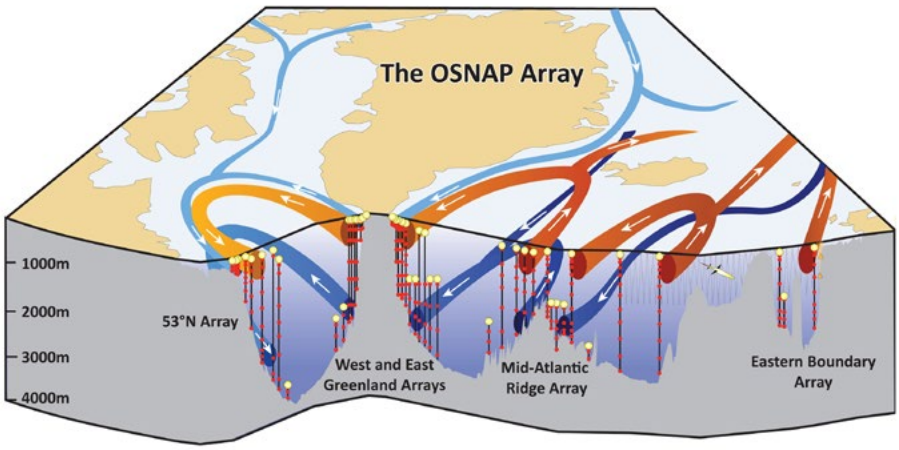
Top: LULA1000 submersible off the southern coast of São Jorge Island; above and below, plus main image: black coral species encountered on the vertical walls of the steep slopes of São Jorge and Pico Islands (Azores). Images courtesy IMAR and Rebikoff Foundation.



Escaping the storms during OSNAP mooring turnarounds

By Kristin Burmeister, SAMS

Image courtesy Lewis Drysdale, SAMS



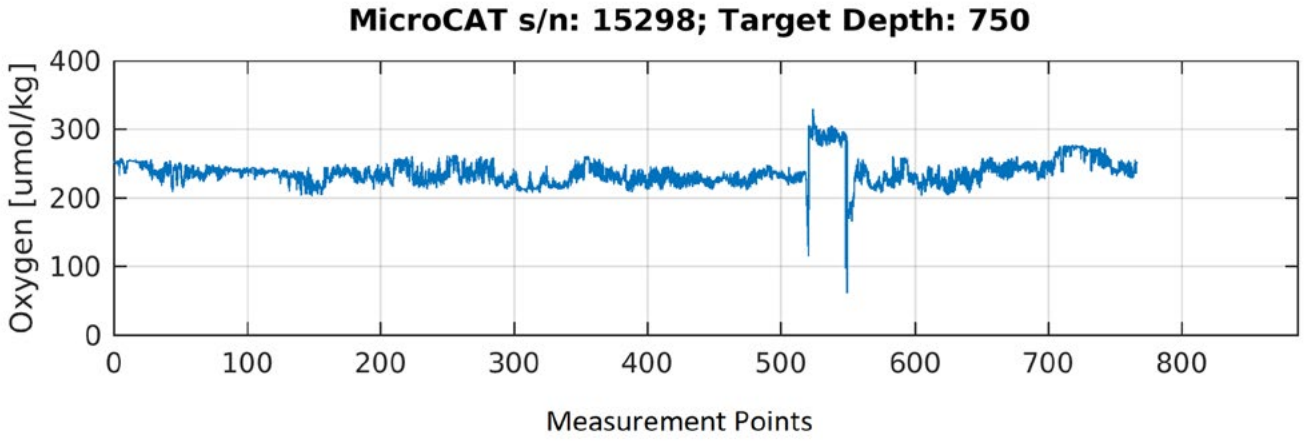
Left: A schematic of the Overturning in the Subpolar North Atlantic Program (OSNAP) oceanpgraphic mooring array. Warm currents in the upper one kilometer which flow north from the Gulf Stream and North Atlantic Current are shown in red. The warm water is made colder as it flows round the subpolar gyre and in the Nordic and Labrador Seas east and west of Greenland. The cold waters in blue return southward to the global ocean at depths of one to four kilometers. This is the overturning circulation. To continuously monitor the strength and structure of all these currents, an array of moorings is continuously deployed between Newfoundland and West Greenland, and between East Greenland and Scotland.

During the recent research cruise DY120 on RRS *Discovery* we – six scientists from SAMS, one scientist from NOC, seven technicians from UK National Marine Facilities, and the full crew of *Discovery* – successfully completed all UK mooring turnarounds along the OSNAP array in the Rockall Trough and the Iceland basin.

The OSNAP array was installed in 2014 to monitor the Atlantic Meridional Overturning Circulation (AMOC). The AMOC is a large system of ocean currents that spans the entire Atlantic. Its upper part transports warm water towards the north, whilst its lower part, deep below the ocean surface, is transporting cold water southwards. The AMOC plays an important role in mixing the world's ocean and distributing heat across the planet impacting the climate. iAtlantic is contributing oxygen sensors to the OSNAP mooring array, which, together with pH measurements (from the ATLAS project), will give new insights on the impacts of AMOC on carbon fluxes.

The data return has been exceptional: one MicroCAT logger stopped logging after a fortnight, and we had one or two instances of fouling. Otherwise all records are 27 months long, which is the longest our PI, Stuart Cunningham (SAMS) ,has left instruments at sea. This is a stunning success given that the moorings survived over two years in some of the roughest places in the ocean.

Our cruise was further challenged by new COVID guidelines which restricted the scientific crew to half its usual size, and by storms which kept popping up but somehow bypassed us, until the penultimate day of the cruise...



Above: Preliminary results of the first oxygen measurements at EB1, an OSNAP mooring in the eastern basin of the Rockall Trough.
Left: Redeploying oceanographic moorings on the OSNAP array in the North Atlantic from the back deck of RRS Discovery (image courtesy Lewis Drysdale, SAMS).

10-year record of near-bottom temperature in the NW Argentine Basin

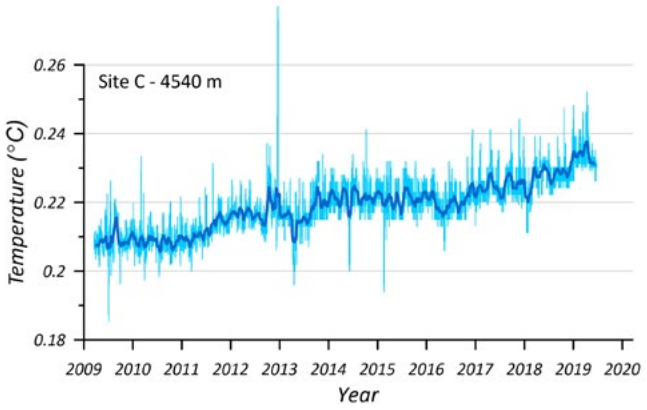
By Alberto Piola, Servicio de Hidrografía Naval, Argentina

Hourly temperature records from inbuilt sensors on bottom-mounted pressure-equipped inverted echo sounders (PIES) moored in the north-western Argentine Basin reveal unprecedented details of the variability in the near-bottom temperature.

The records from about 1 m above the bottom at 1360, 3535, 4540 and 4757 m water depth present energetic variations from daily to interannual timescales, with more intense variations at the shallower locations. The records capture temperature changes close to the cores of Upper and Lower Circumpolar Deep Water as well as the Antarctic Bottom Water, and demonstrate long-term warming trends of 0.02 to 0.04°C over the period 2009–2019.

These data were collected by some of the moored instruments in the western boundary portion of the South Atlantic MOC Basin-wide Array (SAMBA), deployed across the South Atlantic at 34.5°S. SAMBA is part of the international South Atlantic Meridional Overturning Circulation (SAMOC) initiative, and is designed to study the variability of the meridional circulation cells at 34.5°S. SAMOC is led by contributors from Argentina, Brazil, France, Germany, South Africa and the USA.

The SAMBA-West pilot array began in March 2009 with the deployment of four PIES spanning the western slope of the north-west Argentine Basin. The SAMBA-West portion of the trans-basin array has since increased to 10 PIES, with a bottom pressure recorder and an acoustic doppler current profiler both up on the upper continental margin. SAMBA-West will be further enhanced by the addition of one tall mooring to be deployed at 700 m as part of iAtlantic, and a mooring at 3500 m to be deployed as part of iAtlantic's sister project



TRIATLAS (please refer to Chidichimo et al., *Enhancing AMOC monitoring in the North and South Atlantic*, published in Issue 1 of the iAtlantic Newsletter). A complementary 18-month record of near-bottom temperature and velocity data has been recently recovered from the Vema Channel by colleague at Universidade de São Paulo, Brazil. The combined analysis of these observations will provide further understanding of the causes of the observed variability.

These new SAMBA temperature results were recently published: Meinen C.S. et al. (2020) Observed ocean bottom temperature variability at four sites in the northwestern Argentine Basin: Evidence of decadal deep/abyssal warming amidst hourly to interannual variability during 2009-2019. DOI: 10.1029/2020GL089093.

For more information about the SAMOC array please visit www.aoml.noaa.gov/phod/SAMOC_international/

EXEBUS: Extreme Events in the Benguela Upwelling System

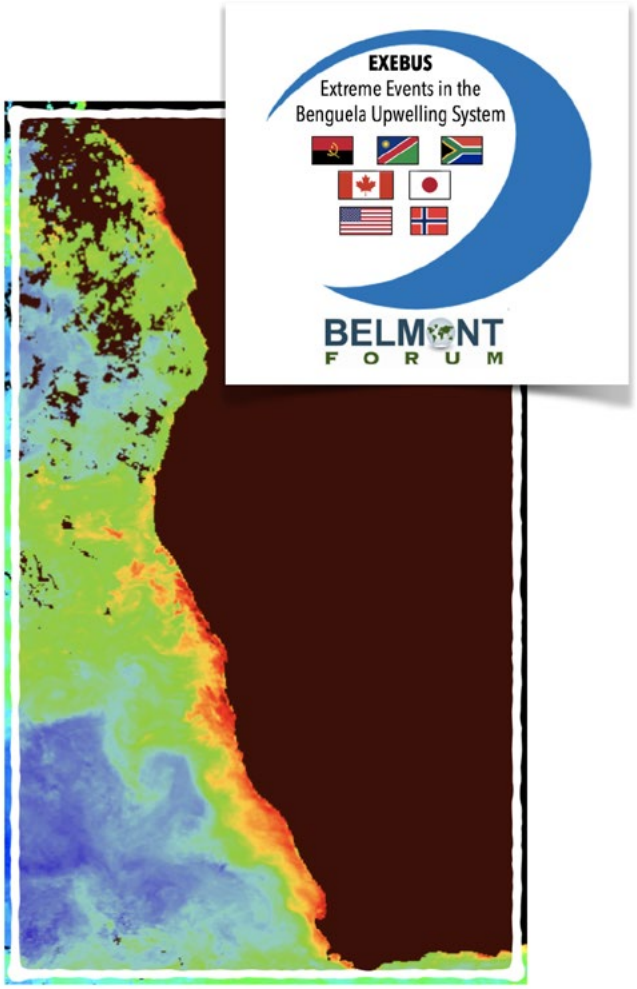
By AJ Smit, University of the Western Cape

The Benguela Upwelling System (BUS) is one four Eastern Boundary Upwelling Systems globally. Changes in the coupled atmosphere-marine climate, natural or anthropogenic, both within the BUS and beyond, affect ecological and socio-economic important sub-systems, potentially affecting millions of people—residents of the coastline and those who derive their livelihoods and resources from the BUS.

EXEBUS undertakes an Integrated Ecosystem Assessment (IEA) to establish the roles, trends, and range of variability and the extremities of natural and anthropogenic geophysical, biological, governance, socio-economic features and phenomena, and assess their impact on ecological, sociological, governance, and macroeconomic systems and processes in the Benguela Current Large Marine Ecosystem of South Africa, Namibia, and Angola. The goal is to strengthen the rational basis for management on relevant spatial and temporal scales up to 2070.

The work is undertaken by transdisciplinary consortium of international researchers, practitioners, and representatives of the private sector and civil society. This will bring unique and complementary perspectives for both understanding the changes in this dynamic system, and applying and communicating the importance of these findings. This will enable the development of an ecosystem-based management framework for application in the region.

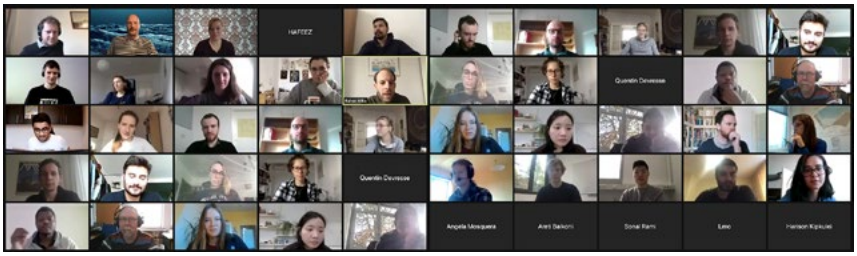
EXEBUS is funded by by the Belmont Forum under the Collaborative Research Area, Oceans: Transdisciplinary Research for Ocean Sustainability. PI: AJ Smit, University of the Western Cape (ajsmit@uwc.ac.za); Co-PI: Neville Sweijd, Alliance for Collaboration on Climate and Earth Systems Science (ACCESS; nsweijd@access.ac.za).



For more information visit www.exebus.org

Big Data training goes virtual

In the new virtual world imposed upon us by COVID-19, we've all had to be innovative in finding ways to continue our work. "Business as usual" now looks very different to a year ago, but the new normal has allowed us to embrace technology as a means to continue collaboration, research and training. In place of an in-person event, colleagues in Germany pressed ahead with a virtual training event on Advanced Scientific Programming over a 2-week period in October. Involving participants from all over the world, this event was an important contribution to iAtlantic's capacity building programme. Future modules, also focused on aspects of using Big Data in research, will be open to external participants, so watch this space.



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MoMARSAT2020: The technical maintenance of a deep-sea observatory during a technically restrictive pandemic

By Loïc Van Audenhaege, Ifremer Deep-Sea lab

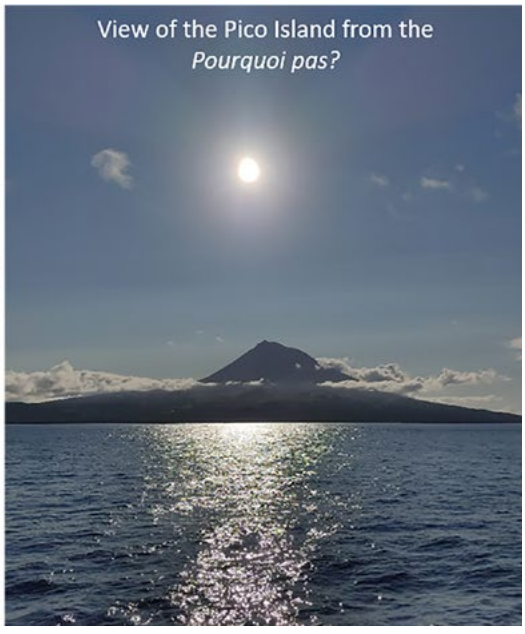
After several months of COVID restrictions casting doubt on the viability of the MoMARSAT2020 expedition, I found myself among a team of 60 scientists, technicians and crew anxiously waiting to embark onto the French research vessel *Pourquoi pas?* to visit the deep-sea observatory at Lucky Strike, on the Mid-Atlantic Ridge.

On 3 September 2020, after 10 days' quarantine in a hotel and two rounds of COVID-19 testing, the full crew and scientists were cleared to board the ship. Once on board, it was not the end of the pandemic-related restrictions - social distancing was maintained for a week, wearing masks, avoiding the gym and exercising strict procedures in common areas. Due to flight restrictions we started our expedition in Toulon (France), sailing over 4000 km via the Strait of Gibraltar to finally reach Horta in the Azores on 12 September. Returning by the same route, arriving back in Toulon on 3 October, the total distance of the MoMARSAT2020 journey reached 8000 km, equivalent to one fifth of the Earth's circumference. This made me realise how remote my PhD study site is and how vast the Atlantic Ocean is!

Despite 18 days of lockdown and sailing, that time was the opportunity for me to engage in conversation with my coleagues, enabling me to build a great connection with the EMSO-Azores group and to talk about science and technology with the team who have a great diversity of experience. Finally, after a further transit of 8 days, we reached the Lucky Strike hydrothermal vent field on the Mid-Atlantic Ridge to start the campaign - shortened to 12 days on site, but nevertheless marking the 10th MoMARSAT expedition.

Hydrothermal vent fields are volcanically active areas where the seawater is heated and dissolves mineral and metal content from the mantle rocks deep in the seafloor. Continuous release of hydrothermal fluids through smokers can build spectacular vertical structures hosting a unique faunal community. Despite the high toxicity and temperature in and around these vents, some microorganisms are able to generate energy from chemicals in the hydrothermal fluid through chemosynthesis, and in turn support a whole biological community which thrives in these extreme conditions. To fully understand processes taking place at the Mid-Atlantic Ridge, we must approach the hydrothermal ecosystem with a multidisciplinary approach, and consider different scales of space and time in our studies.

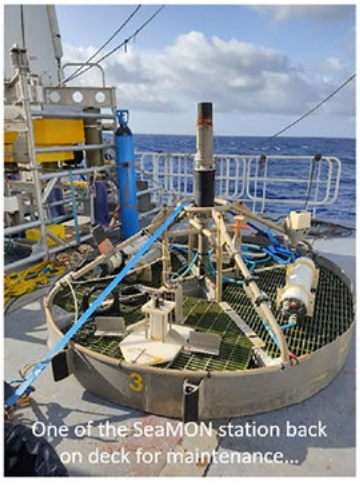
The EMSO-Azores non-cabled multidisciplinary observatory is devoted to the long-term integrated study of mid-ocean ridge processes, from the water column to the sub-seafloor. This deep-sea observatory, part of the EMSO-ERIC European consortium, enables the acquisition of long-term, high-frequency and continuous information on microbiological, ecological, geochemical and seismic processes taking place

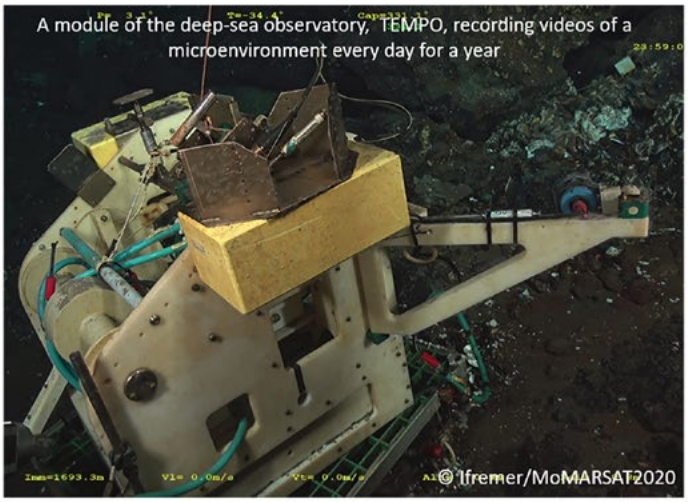


at the Lucky Strike vent field. Various instruments (e.g. probes, camera and repetitive sampler) are mounted onto modules of the observatory, which are connected to two nodes storing the collected datasets and supply the modules with energy. The nodes transfer the data using acoustic transmission to a buoy at the surface, which then conveys the information via satellite transmission to the IFREMER centre at Brest (France). This deep-sea observatory is therefore a technological challenge, as it must supply energy for a year and store large volumes of data that cannot be always sent by satellite (e.g. video).

The objective of the annual MoMARSAT expedition is principally to maintain this deep-sea observatory, but also presents an opportunity to collect samples and conduct observations. The RV *Pourquoi pas?* is equipped with two different cranes that can be operated simultaneously, so the Remotely Operated Vehicle (ROV) Victor6000 can be deployed alongside other cabled instruments. Using two cranes at the same time is necessary during the MoMARSAT cruise as it has an intense programme involving many ROV-assisted technical operations, from transporting the cabled modules to the nodes, extracting the data, hooking and lifting the heavy observatory nodes on deck for a week of maintenance. Meanwhile, during the dives, an elevator is repeatedly brought back on deck, transferring equipment to and from the ROV at the seafloor in order to optimise the amount of activities that can be completed. This array of operations involves the daily cooperation between engineers, scientists, the ROV team and the ship crew. The buoy and both nodes were all redeployed successfully for another year of data collection to shed light on the functioning of the intriguing deep-sea hydrothermal systems.

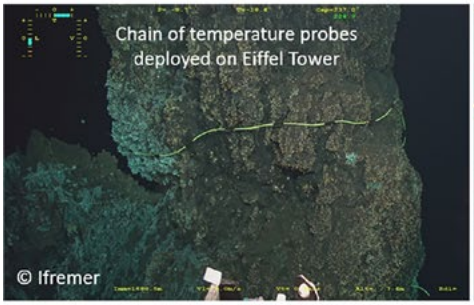
To me, this expedition was a completely new experience, as the goal was not to explore a site but rather to perform in-situ and precise manipulations using a ROV. In the framework of my PhD project, I was in charge of supervising different deployments such as a 70 m chain of 100 temperature probes and 4 current meters placed at the Eiffel Tower edifice. I also had to assist the redeployment and reconnection of the TEMPO ecological module that records daily video sequences of a hydrothermal mussel assemblage, and the deployment of the associated environmental module that measures temperature, iron and sulphide concentration for the characterisation of the physico-chemical conditions in the field of view. I was also in charge of conducting various imagery transects of the seabed, of collecting chemistry and image data for an experiment on monitoring faunal recovery after an induced disturbance (part of the H2020 MERCES

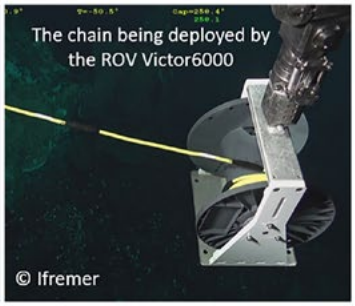


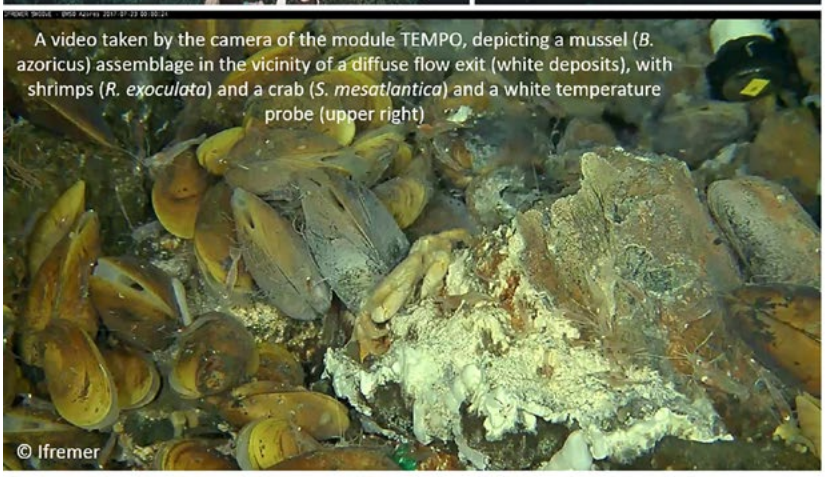


project), and involved in the collection of several species of the Lucky Strike vent fauna: the endosymbiotic mussels *Bathymodiolus azoricus*, the shrimp *Mirocaris fortunata* and gastropods (*Peltospira smaragdina, Lepetodrilus atlanticus*) for colleagues who had to stay back at base due to the pandemic. Finally, as part of my PhD, I supervised ROV transects to reconstruct in 3D the topography of hydrothermal edifices using image photogrammetry. A new model of the Eiffel Tower was generated to study changes of assemblage distribution on a 5-year temporal series of 3D models. In addition, models of the Sintra edifice and the spectacular Capelinhos edifice were reconstructed in order to characterise the distribution of assemblages for comparison to those at the well-known Eiffel Tower. All these data will help to identify the environmental factors (e.g. habitat, current exposure) that drive assemblage spatial distribution at the edifice scale, and to understand what factors affect the long-term dynamics of vent assemblages at Lucky Strike.

Despite few days of storm and few technical issues, a total of 9 ROV dives have offered me a better ecological interpretation on the heterogeneity of the hydrothermal environment among active edifices, within a vent site and between active and inactive areas.







IceDivA: Investigating deep-sea biodiversity from Iceland to the Azores

By Saskia Brix, Mia Schumacher & James Taylor

In January 2021, the IceDivA expedition aboard RV *Sonne* (SO280) will focus on species distribution in a unique habitat located deep in the North Atlantic. Scientists will sample deep-sea organisms along a north-south transect between 50°N and 25°N in water depths of between 4,000 and 5,000 m to shed light on the biodiversity of this largely unknown abyss. IceDivA builds on several previous projects, picking up where the IceAGE3 expedition (SO276, summer 2020) finished. A central aspect of IceDivA is the integration of data from previous expeditions, so sampling will use the same equipment and adopt the same techniques as before. This will ultimately allow depth and latitudinal comparisons, on an Atlantic-wide scale, of biodiversity and species composition. Identification and understanding of these deep-sea habitats relies on a coherent and extensive mapping of the seafloor, which is an important part of IceDivA and will be carried out using hydroacoustics.

The IceDivA expedition combines the ambitions of previous deep-sea projects IceAGE (Icelandic marine Animals: Genetics and Ecology) and DIVA (Latitudinal Gradients in BioDIVersity in the deep Atlantic), as well as those of the EU project iAtlantic. Following on from the southernmost station of the IceAGE3 expedition, IceDivA will proceed along a latitudinal gradient that eventually connects to the BIODIAZ project study area (Controls in benthic and pelagic BIODIversity of the AZores). The mission plan coincides with regions of interest for iAtlantic, such as the Porcupine Abyssal Plain and Azores Plateau, and will contribute to the project's key objectives.

A healthy ocean is crucial to the survival of all living things on Earth, but many of the creatures inhabiting it are still a mystery. We can only protect what we know and, above all, understand. How do millimetre-sized organisms travel in absolute darkness and cold? What are the pathways connecting the deep-sea basins and plains? The IceDivA team on board the RV *Sonne* will provide information to help answer some of the fundamental questions about Atlantic ecosystem connectivity.

In addition to the biological work planned during SO280, the "DArgo2025_RBRpilot" project team will also be on board, deploying 10 ARGO floats equipped with a range of sensors to measure salinity, temperature and pressure. The performance of the sensors - sourced from different manufacturers – will be assessed and compared. During the voyage, the floats will be deployed as a swarm in order to take initial benchmark measurements, accompanied by the ship-based CTD that will sample the water column to provide a baseline reference for the assessment of the ARGO float data. During the entire journey of the RV *Sonne*, the floats will execute several measurement cycles, descending to 2000 m and returning to the surface 48 hours later to transmit their data to shore via satellite transfer.

iAtlantic will bring coverage of the IceDivA expedition as it happens - stay tuned to the website for updates!

Left: Map showing the planned route for the IceDivA expedition in Jnuary 2021. After a long transit from Emden in Germany, the mission starts where the IceAGE3 expedition finished, indicated by station WA-1 on the map. The team will then undertake a long sampling transect moving southwards across the abyss, before heading back to Germany.

Stressed abyssal ecosystems: paper and public outreach on deep-sea mining

By Danielle de Jonge, Heriot Watt University

Abyssal systems are large stretches of soft-sediment seafloor occurring between 2 and 6 km water depth. They cover more than 50% of the Earth's surface and host many weird and wonderful creatures. Some abyssal areas contain metal-rich mineral deposits called polymetallic nodules, which are currently being prospected for deep-seabed mining.

I started in the iAtlantic project relatively recently with the task of assessing the effects of multiple stressors on deep soft-sediment ecosystem functioning. A large and omnipresent stressor for abyssal systems will be climate change. A recent study[1] has demonstrated a small but measurable increase in temperature in the abyssal South Atlantic over the last decade already. Potential future mining of polymetallic nodules will be an additional stressor to these abyssal sediments, adding to the stress caused by climate change.

Our recent research[2] has found that abyssal ecosystem functioning was still impacted from a simulated mining event decades after the initial disturbance, when compared to an undisturbed reference site. From our food-web modeling exercise, we estimated overall carbon cycling by the system was reduced by 16%, mostly caused by a reduction of 35% in microbial carbon cycling. We saw variable responses in faunal carbon cycling depending on size class and trophic guild. However, against expectations, overall faunal carbon cycling was recovered to, and in some cases even exceeded, reference values.

I am proud to say this research was my first first-author scientific publication, a really good way to kick-off my PhD journey! We decided to issue a press release[3] to reach out to people about this research, which has societal interest. This led to my participation in a long-read article in *The Correspondent*[4] on deep-sea mining. I was also invited to engage with readers online by answering any questions and stimulating discussion in the comment section below the essay. I can heartily recommend this type of public outreach about your field of expertise! The conversation with the (very critical) readers forced me to correctly and concisely communicate our current state of knowledge on these deep ecosystems.

Deep-seabed mining will undoubtedly harm the communities directly impacted; so far the studies of mining simulations all confirm this to some extent. The current debate is now focused on the temporal and spatial scale of the impact, the mitigation and recovery possibilities, and the potential synergies with other stressors, such as those imposed by climate change. The latter is exactly what I'm looking into within iAtlantic.

For iAtlantic I will perform another food-web modeling exercise to assess abyssal carbon and nitrogen cycling in food-rich and food-poor areas under present-day and future climate scenarios. We distinguish areas based on food availability, because it is one of the factors – if not *the* main factor – influencing community structure and dynamics in deep sediments. Climate change is predicted to reduce the quality and quantity of food reaching the deep seafloor. Our research into the effects of deep-seabed mining showed a diet shift: fauna that ate both bacteria and detritus relied more heavily on detritus grazing after sediment disturbance, because the microbial biomass and activity was reduced.

It will be very interesting to see how these two stressors potentially interact. Will a reduced food input due to climate change have a disproportionate negative effect on fauna in disturbed sediments because they have become more reliant on detritus in the absence of bacteria? Or will the reduced bacterial activity due to mining result in less bacterial degradation of detritus, leaving more detritus for faunal communities and thereby alleviating some of the effects of reduced food input under climate change scenarios? Cliffhanger! I don't know. The complexity of food-web interactions and feedback loops make it difficult to predict such effects. Food-web modeling studies like the one I'm conducting can help provide an insight in such complex interactions. I will keep you posted!

Read the full article:
de Jonge et al. (2020) Abyssal food-web model indicates faunal carbon flow recovery and impaired microbial loop 26 years after a sediment disturbance experiment. DOI: 10.1016/j.pocean.2020.102446

1 https://doi.org/10.1029/2020GL089093

2 https://doi.org/10.1016/j.pocean.2020.102446

3 www.mpi-bremen.de/en/Deep-seabed-mining-lastingly-disrupts-the-seafloor-food-web.html

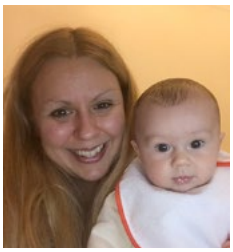
4 thecorrespondent.com/750/we-dont-really-know-whats-living-in-the-deep-sea-but-its-about-to-become-an-industrial-zone/

Congratulations!

iAtlantic Fellow Kelsey Barnhill takes on All-Atlantic Ocean Youth Ambassador role

"I am very excited to have been selected as the All-Atlantic Ocean Youth Ambassador for the United Kingdom," said Kelsey (pictured below) on her appointment. "I am honoured to follow in the footsteps of my colleague, iAtlantic Fellow Johanne Vad, who did an excellent job in the inaugural year and will be acting as a mentor for myself and the rest of this year's cohort. I decided to apply to promote the need for increased exploration and protection for Atlantic deep-sea ecosystems. I aim to push deep-sea issues to the forefront of the All-Atlantic Ocean Youth Ambassadors' agenda. During my tenure, I also hope to strengthen ties between All-Atlantic Ocean Youth Ambassadors and iAtlantic Fellows, as I would like to see more early career researchers collaborate across Atlantic projects."

Celebrating a new arrival...



Huge congratulations and warm wishes to iAtlantic's project manager Mila Vukomanovic, who celebrated the arrival of baby Luka (right) in August. A new marine scientist in the making, perhaps...?

ATLAS wins Atlantic Project Award 2020

iAtlantic's predecessor, the ATLAS project, has won the Atlantic Project Award 2020 for the category 'Developing International Cooperation'. The results were announced on 19 November during the 7th Atlantic Stakeholder Platform Conference.

The Atlantic Project Awards were established in 2016 as a way to honour outstanding success stories, achieved by projects in the geographical area covered by the Atlantic Strategy that showcase relevance to the implementation of the Atlantic Action Plan.

"This great achievement would not have been possible without all the partners' efforts and input during the four-year journey of ATLAS," said Murray Roberts, ATLAS Coordinator. "It is this great input from partners in Europe, Canada and USA which has led to more than 110 peer-reviewed publications and 103 million people reached by ATLAS".

The ATLAS partners have expressed their gratitude for this award through a special "Thank you" video – assembled by the Project Office and videographer Alex Ingle – which was presented during the award ceremony. In case you missed it, you can see it in the ATLAS twitter feed: twitter.com/eu_atlas Congratulations!

iAtlantic's Georgios Kazanidis Highly Commended in conservation awards

Exciting news as Dr Georgios Kazanidis has recently been awarded Highly Commended in the "*Nature of Scotland – Conservation Science Award for Early Career Researchers*"! This was a recognition of Georgios' contribution over the last nine years in improving our understanding about the impacts of human activities and climate change on Vulnerable Marine Ecosystems in Scotland (e.g. deep-sea sponge aggregations in Faroe-Shetland Channel) serving their conservation. In addition, the panel recognised his contribution in translating science to policy – for example, he co-led the ATLAS work on facilitating the implementation of the EC's Marine Strategy Framework Directive in the deep North Atlantic and also led the ATLAS & iAtlantic input to the Scottish Government's consultation, which led to the recent establishment of the largest marine protected area in Europe (see https://tinyurl.com/y67mk4l8). Georgios is a passionate science communicator across wide audiences, as he believes that raising public awareness is a key thing for the conservation of the marine environment for future generations. Georgios (pictured right) would like to thank the Scottish Alliance for Geoscience, Environment and Society (SAGES) for sponsoring the Conservation Science category awards.

Mapping cold-water coral biomass: an approach to derive ecosystem functions

By Laurence H. De Clippele, Lorenzo Rovelli, Berta Ramiro-Sánchez, Georgios Kazanidis, Johanne Vad J, Simone Turner, Ronnie N. Glud & J. Murray Roberts

Image courtesy Changing Oceans Expedition 2012 (cruise JC073) U. Edinburgh

Climate change models predict global increases in ocean temperatures, as well as associated increases in ocean acidification and decreases in ocean oxygen levels. These changes might affect ocean currents, organisms' metabolic demands and the export flux of particulate organic matter (POM), ultimately affecting the amount of biomass deep-sea ecosystems can support and consequently affecting ecosystem processes such as carbon (C) cycling. Quantifications of the current status of ecosystems in terms of biomass and C turnover are thus needed to better comprehend future changes in ecosystem functions.

Existing marine biomass assessments are usually based on single spot measurements, which do not reflect the spatial heterogeneity of natural ecosystems. While terrestrial studies can exploit remote sensing (e.g. satellite imagery) in combination with field measurements to map biomass at the ecosystem scale, this approach is not applicable to deep-sea habitats. A clear need to map deep-sea biomass led to the development of a novel approach, which we used on two important ecosystem engineers, the cold-water coral *Lophelia pertusa* and sponge *Spongosorites coralliophaga* at the Scottish cold-water coral reef, the Mingulay Reef (pictured above). This method involves using surface area data from high-definition (HD) videos in combination with field measurements and predictive modelling techniques to create biomass maps. From these maps it is possible to

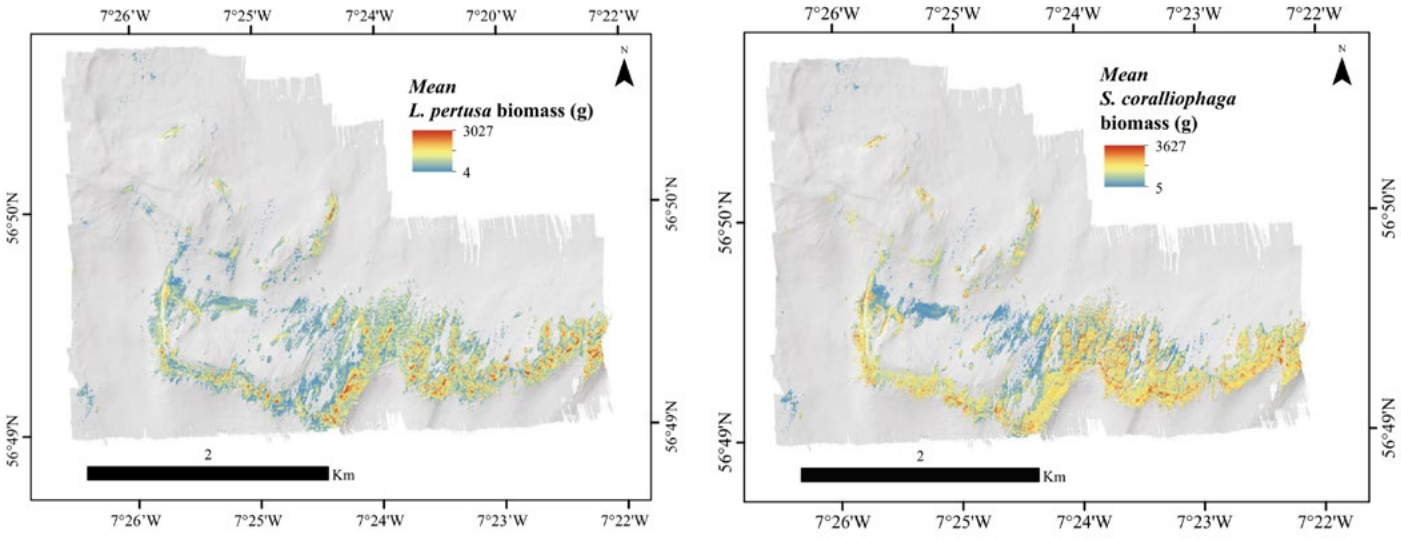


Figure 1: Modelled amount of the mean biomass of live Lophelia pertusa *(left) and* Spongosorites coralliophaga *(right) in the* Lophelia *reef habitat area of the Mingulay Reef.*

calculate whole-reef surface C stock and turnover using values such as oxygen consumption and respiration rates available through the literature (Figure 1).

The mean skeletal mass of the *L. pertusa* coral colonies (live and dead framework) is estimated to be 3,874 T, containing a mean of 209 T of biomass and a mean of 465 T C stock. The whole-reef mean biomass of *S. coralliophaga* is estimated to be 304 T, containing 10 T C stock. These calculations reveal that the epi- and microbial fauna associated with coral rubble is the largest contributor towards C turnover in the area with a mean of 163 T C year^{-1}. The live and dead framework of *L. pertusa* is estimated to overturn a mean of 32 T C year^{-1} and 44 T C year^{-1}, respectively (Figure 2). These results further emphasises the importance of cold-water coral reefs as hotspots for benthic mineralisation. Carbon turnover at the Mingulay Reef is three to seven (with a mean of four) times higher than the global average for soft-sediment at the same depth.

An additional advantage of estimating the annual amount of C turnover is that you can quantify the importance of the different C supply pathways (e.g. by natural deposition and tidal downwelling) of C from surface water primary productivity (PP) to the reef. The estimated maximum amount of C supplied from PP through natural deposition (124 T C year^{-1}) is close to the minimum amount of C reef turnover (160 T C year^{-1}). This illustrates that monitoring and/or managing surface PP would be a key consideration for any conservation efforts of this cold-water coral reef ecosystem.

Finally, such biomass maps can guide sampling and monitoring expeditions, help identify areas that should be protected from human activities, and even potentially predict areas that could have marine biotechnological potential. Furthermore, this work advances our nascent knowledge of carbon storage in cold-water coral habitats and the significance of their secondary productivity, one of the criteria used to define ecologically or biologically significant marine areas (EBSAs).

Lead author of this work, Laurence De Clippele

Read the full article (open access):

De Clippele, L.H., Rovelli, L., Ramiro-Sánchez, B. et al. (2020) Mapping cold-water coral biomass: an approach to derive ecosystem functions. Coral Reefs. DOI: 10.1007/s00338-020-02030-5

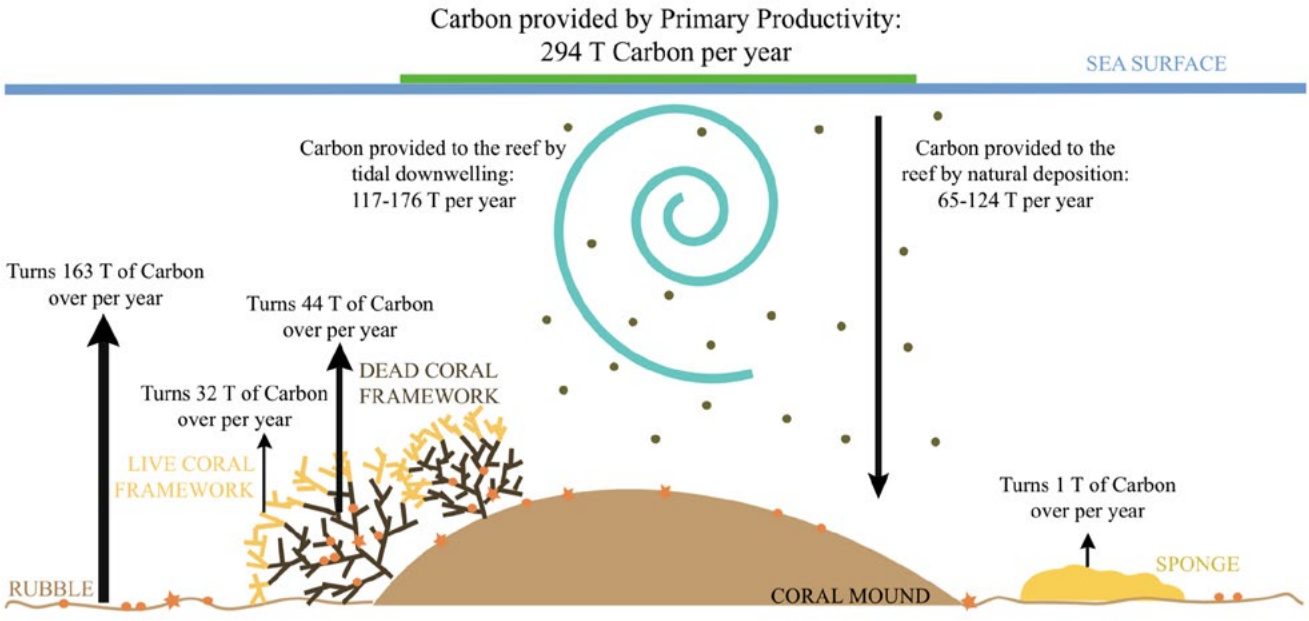


Figure 3: Diagram representing the Mingulay cold-water coral reef, the mean amount L. pertusa *rubble, live and dead framework and the yellow encrusting sponge* S. coralliophaga *contribute to the carbon turnover. The orange circles and stars represent the fauna (including dense* Parazoanthus *sp. and ophiuroids) and microbes associated with the rubble and dead coral framework. The dark green circles represent the organic matter that is transported from the surface water to the reef. The diagram also shows an estimate of the amount of primary production above the reef and the contribution of two supply pathways to the reef, natural deposition and tidal downwelling. The given range refers to the deeper and shallower area of the reef, respectively.*

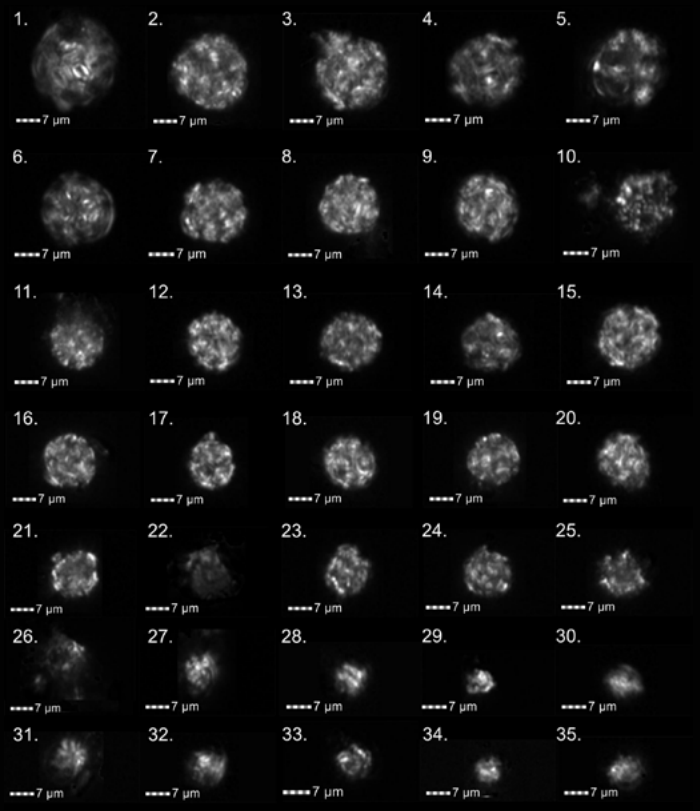
Imaging the past – a novel method to examine marine ecosystem changes in sediment cores

By Beth Langley (U. Exeter), Paul Halloran (U. Exeter) and David Thornalley (UCL)

A key objective of the iAtlantic project is to examine marine ecosystems' response to climate and ocean circulation change. Modern observations provide a fantastic insight into recent processes, however they only go back so far - typically just a few decades at best. To look further back in time and examine ecological responses on multidecadal to centennial time scales, we need to use climate archives. One such approach uses marine sediment cores and examines the fossils found within the layers of mud. As layers of mud and the fossils of organisms that used to live in the ocean settle on the seafloor, they build up a record of how both climate and marine ecosystems have changed through time. As part of the iAtlantic and the ATLAS projects, we have been looking at past changes in foraminifera – single-celled protists that form an important part of the zooplankton and benthos. We have used marine sediment core archives of the variations in the different species of foraminifera to help reconstruct past changes in ocean circulation[1] and to provide longer-term context for changes in both circulation and marine ecosystems in the Northeast Atlantic[2]. However, there are other organisms that form major constituents of the marine ecosystem that need to be examined too. One such group of organisms are coccolithophores.

Coccolithophores are single-celled marine algae and are one of the most abundant types of phytoplankton. Alongside foraminifera they are primary producers of calcium carbonate, playing a key role in the Earth's carbon cycle, as well as being the microscopic building blocks of chalk, which forms the famous White Cliffs of Dover. Coccolithophores produce delicate plates called 'coccoliths', which interlock to form a 'coccosphere' that surrounds the soft-bodied algae inside. Upon death, the calcium carbonate remains sink to the ocean floor where they become preserved in the sedimentary record. Fossil coccospheres provide information that can be related directly to the former living coccolithophore, such as cell size, that can inform us of many aspects of marine ecology and biogeochemistry, including response to climate change. A major challenge of reconstructing past cell size is the rare preservation of coccospheres since they often break apart into their separate coccoliths. Fossil coccolithophore studies are therefore largely based on individual coccoliths in order to extract reliable cellular level information, we must have an understanding of the coccospheres from which they are derived.

As part of her MSc project, Beth Langley, from the University of Exeter, and her supervisor Dr Paul Halloran, have developed a novel technique to hunt for coccospheres within sediment. The method combines imaging flow cytometry and cross-polarised light to visually isolate and analyse coccospheres from sediment. By utilising the optical properties of calcite and classifying the morphological characteristics of a cultured coccolithophore sample, they constructed a protocol to sort images of coccospheres from other marine sediment particles. The protocol was applied to marine sediment from the core used in Spooner et al. (2020)[2] to detect coccospheres which can be seen in the image below. Morphological information can be extracted from these images to enable cell size to be reconstructed.



Above: Images of coccospheres identified from the core used in Spooner et al. (2020).

1 Thornalley et al. (2018) Anomalously weak Labrador Sea convection and Atlantic overturning during the past 150 years. DOI: 10.1038/s41586-018-0007-4

2 Spooner et al. (2020) Exceptional 20th Century Ocean Circulation in the Northeast Atlantic. DOI: 10.1029/2020GL087577

Working with Dr David Thornalley, preliminary investigations of past coccolithophore cell size have been conducted on a core from south of Iceland which has an exceptionally high sedimentation rate. These records will be compared to observational datasets of ecological changes in the NE Atlantic over the past few decades, as well as the previous reported shifts in the foraminiferal assemblage conducted by the ATLAS project (Spooner et al., 2020). This new technique has the potential to enable rapid processing of down-core sediment records to provide a unique insight into the past response of one of the major marine phytoplankton groups to paleoceanographic changes, at sites throughout the Atlantic basin – an exciting new tool for the paleoceanographer's and paleoecologist's toolbox!

Read the full paper:

Langley, B., Halloran, P.R., Power, A. et al. (2020) A new method for isolating and analysing coccospheres within sediment. Sci Rep 10, 20727. DOI: 10.1038/s41598-020-77473-5

How do cold-water coral recruits cope with sediment?

By Covadonga Orejas (IEO), Juergen Laudien, Marie Koch & Claudio Richter (AWI)

To answer this question, Marie Koch, a marine biology student from Bremen University, is conducting her practical work at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) in Bremerhaven, Germany. The cold-water corals (CWC) she is working with are from Comau Fjord in Patagonia, Chile - a region characterised by heavy rainfall and copious terrigenous inputs of sediments. CWC live on the steep walls of the fjord, crowded under overhangs, so it is believed – but was never proved – that sediments govern the CWC distribution in Comau Fjord.

Marie (pictured right) started her aquaria experiments in October. She is trying to find out how the recruits of the CWC species *Caryophyllia huinayensis* behave by measuring different parameters (respiration, growth, polyp behaviour) under different sediment loads, simulating the natural sediment concentration of the location where they naturally thrive as well as under scenarios of future potential increasing sediment loads.

Increasing sediment load in marine ecosystems is one of the consequences of global change but also of other anthropogenic activities (e.g. road construction close to the coast, underwater drilling activities, resuspension from bottom trawling). This stressor is important for CWCs, as it can reduce food capture efficiency by separating organic from inorganic particles, and increase energy expenditure by causing the coral to slough off mucus in order to wash off the sediments. Our knowledge on the effects of increasing sediment load for CWC is scarce and reduced to a single species, *Lophelia pertusa* (i.e. Larsson & Purser, 2011); no information is available for other species and nothing is known about how this stressor can affect the larval phase and juvenile stages of CWCs. The experiments Marie is conducting will shed light on these unknown aspects and increase our knowledge about how corals react to stressors through their different life stages.

Maria's work is being carried out in the "Bentho-Pelagic Processes" section led by Prof. Dr Claudio Richter at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) in collaboration with Dr Cova Orejas (IEO), with co-supervision from Drs Jürgen Laudien and Marlene Wall (AWI). The experiments are part of AWI's contribution to the Helmholtz research programme "The Changing Earth – Sustaining our Future", to AWI's strategy fund DACCOR, and to WP4 of iAtlantic.

Introducing the All-Atlantic Joint Actions

BUILDING AN ALL ATLANTIC OCEAN COMMUNITY
Implementing the Belém Statement

The All-Atlantic Ocean Research Alliance and the AANChOR CSA

The All-Atlantic Ocean Research Alliance is the result of science diplomacy that aims at enhancing marine research and innovation cooperation along and across the Atlantic Ocean, from the Arctic to Antarctica. The Atlantic Ocean Research Alliance between the European Union, Canada and the United States was launched with the signature of the Galway Statement in May 2013. Its success, together with existing initiatives that were already being implemented between various partners in the South Atlantic, was seen as an opportunity to build an ambitious cooperation to address the challenges of the Atlantic as a whole. Since then, cooperation was enhanced, culminating in the signing of the Belém Statement in July 2017 between the EU, Brazil, and South Africa. In 2018, the EC then signed bilateral Administrative Arrangements with Argentina and Cabo Verde. Taking a systemic approach to the challenges and opportunities offered by the Atlantic Ocean, we are now expanding to an All-Atlantic Ocean Research Alliance. Within such massive cooperation programme, the AANChOR Coordination and Support Action was launched in 2018 to support the implementation of the Belém Statement, namely through the construction of the All-Atlantic Ocean Research Community, a group of people and institutions whose research and innovation is directly linked to the Atlantic Ocean.

The All-Atlantic Joint Actions

A key activity within AANChOR involves the creation of several stakeholders' platforms to bring together groups of experts for selected key aspects of ocean research cooperation. Each stakeholder platform has designed a set of innovative and long-term Joint Actions. In 2021, these will receive seed money from AANChOR for the initial stages of their implementation. The selected Joint Actions were presented during the 3rd All-Atlantic Ocean Research Forum on 3-4 December 2020. Here's a summary of their main objectives:

Capacity Development

Align EU Blue Economy training programmes, including through industrial apprenticeship, and networking, with national programmes in Atlantic countries and international programmes, and create innovative approaches in capacity development to overcome ocean issues.

Knowledge Transfer for Ocean Innovation and Economy

Pave the way to establish an All-Atlantic Knowledge Transfer Network for Ocean Innovation and Blue Growth in order to foment industry-academia interactions, raise awareness to ocean-related technological developments, and help to achieve the goal of developing new marine technologies.

Common Standards for Information and Data Sharing

Define the minimum information needs for the natural-, social- and humanistic- scientific transatlantic ocean data and define a minimum set of ocean standard data formats and data exchange formats.

Ocean Citizen Awareness and Literacy

Define the conditions for a successful transatlantic stakeholders' community in ocean literacy and create actions, tools and approaches considering the different cultures along and across the Atlantic.

Convergence and Alignment of R&I Initiatives

Support the development of a transatlantic network of RI initiatives promoting the convergence and the alignment of RIs and promote Trans-National Access (TNA) to RIs in the Atlantic area.

To stay up to date about the Joint Actions and other relevant matters related with the All-Atlantic Cooperation, subscribe to the newsletter and follow us on Twitter and Facebook:

allatlanticocean.org/contacts
twitter.com/AllAtlanticO
www.facebook.com/AllAtlanticOcean/

ASTRAL: A collaborative ecosystem for Atlantic aquaculture

ASTRAL will develop new sustainable and profitable value chain systems for aquaculture production in the Atlantic region

Image courtesy GMT (Ireland)

ASTRAL (All Atlantic Ocean Sustainable, Profitable and Resilient Aquaculture) is a HORIZON 2020 project recently financed under the Blue Growth programme, with a budget close to €8 million and led by the Norwegian Research Centre (NORCE). The project will contribute to the implementation of the Belém Statement to develop a strategic partnership on marine research and it will participate in building the All Atlantic Ocean Community.

The project main goal is to increase value and sustainability for integrated multi-trophic aquaculture (IMTA) production by developing new, resilient and profitable value chains. In IMTA production, multiple aquatic species from different trophic levels are farmed together. Waste from one species is used as input (fertilisers and food) for another species. The IMTA process will be used at four 'labs' in Scotland, South Africa, Brazil and Ireland; these sites will grow species such as fish, scallops, lobsters, oysters, urchins and seaweed. A prospective IMTA lab will also be assessed for future production in Argentina.

ASTRAL goals include the increase of circularity and the achievement of zero-waste aquaculture systems, as well as the creation of appropriated business models to increasing profitability. Potential climate risks and emerging pollutant (microplastics, harmful algae blooms, pathogens) will be assessed, together with the development of innovative technology (specific sensors and biosensors, IoT and AI data analytics), with the final aim to provide monitoring recommendations to policy makers. Sharing knowledge and capacity development are among ASTRAL priorities, to build a collaborative ecosystem along the Atlantic Ocean with industrial partners, SMEs, scientists, policy makers, social representatives and other relevant stakeholders.

The ASTRAL consortium assembles a multidisciplinary team of experts from different disciplines as well as SMEs, industrial clusters, intergovernmental organisations and other relevant stakeholders from several Atlantic countries.

"In ASTRAL, we have the best possible basis to fulfil the project's main goal, both for the northern and southern regions: to make aquaculture practices more sustainable, increasing the circularity, the resilience and the profitability", says project coordinator Elisa Ravagnan.

The ASTRAL consortium includes 16 partners from 10 countries - Norway, Scotland, Ireland, France, Spain, Portugal, Nigeria, South Africa, Argentina and Brazil, and include research and technology organisations, universities, SMEs, as well as associations/industrial clusters.

"We are very excited to start this project," says Elisa, "and we are looking forward to collaborate with stakeholders from both sides of the Atlantic, as well as with all the projects financed under the same programme, such as iAtlantic, to build together the best solutions for sustainable aquaculture in the Atlantic Ocean".

The ASTRAL project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 863034.

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MISSION ATLANTIC: investigating Atlantic marine ecosystems under influence of climate change and exploitation

Launched in September 2020, MISSION ATLANTIC is the latest project to join the EU Horizon 2020 cluster funded to support Atlantic Ocean Research and Innovation and implementation of the Belém Statement.

MISSION ATLANTIC will be the first initiative to develop and systematically apply Integrated Ecosystem Assessments (IEAs) at Atlantic basin scale.

Bringing together 32 partners and two associated government organisations from a total of 15 countries in Europe, Brazil, South Africa, Canada and the USA, MISSION ATLANTIC will map and assess the current and future risks from climate change, natural hazards and human activities to Atlantic ecosystems.

MISSION ATLANTIC has five key objectives:

1. **Assess ecosystems status and resilience in the whole Atlantic Ocean** to the cumulative impact of food provision, climate regulation and cultural services.
2. **Map the present and establish the future 3D distributions of Atlantic biomes and their pressures** to support the sustainable use of marine resources.
3. **Develop new indicators, tools and technologies to identify risks and vulnerabilities** of the Atlantic Ocean under different climate conditions and management scenarios.
4. **Formulate and transfer assessment guidelines, data and modelling tools into ecosystem-based management procedures** to support sustainable governance of marine resources and the development of the Blue Economy
5. **Educate ocean resource managers and researchers in application of a systemic approach to ecosystem management** (e.g. IEAs) with/in countries bordering the North, South and Tropical Atlantic Ocean.

Centred around seven case studies in the Norwegian Sea, Celtic Sea, Canary Current System, North Mid Atlantic Ridge, South Mid Atlantic Ridge, Benguela Current, and South Brazilian Shelf, the team will develop and apply the unique IEA approach.

Using high-resolution ocean models, artificial neural networks, risk assessment methods and advanced statistical approaches, MISSION ATLANTIC will accurately assess pressures imposed on Atlantic marine ecosystems, identifying the parts most at risk.

The team will combine existing data from global ocean monitoring programmes with new observations collected

using advanced marine robots and acoustic sensors. A truly multidisciplinary approach, these tools will be used to explore plankton and fish distribution in unknown waters, including sub-Arctic and Tropical regions in the Atlantic Ocean.

In addition to expanding scientific knowledge of the Atlantic Ocean, MISSION ATLANTIC will focus on improving education and professional development opportunities in countries bordering the North, South and Tropical Atlantic Ocean. Regional stakeholder platforms will act as "science to governance" interfaces in these areas, enabling local communities to engage with their representatives and stimulate effective policies.

The MISSION ATLANTIC team look forward to collaborating with iAtlantic, together with our other sister projects, and contributing to the commitments outlined in the Belém Statement on Atlantic Ocean Research and Innovation Cooperation between the European Union, Brazil and South Africa, and as part of the UN Decade of Ocean Science (2021-2030), supporting society in achieving a sustainable ocean.

More information coming soon on missionatlantic.eu. Follow the project on twitter @MISSIONATLANTIC

Missed an iAtlantic webinar? No problem - watch on demand!

No doubt everyone has spent more than a sensible amount of hours on video conferences during 2020, but the rise of virtual meetings has not only allowed us to continue important discussions, planning and collaborations, it has also offered us the opportunity to undertake valuable knowledge sharing whilst the international travel ban prevents us from meeting in person.

iAtlantic's diverse programme of in-person and at-sea capacity building activities have largely been placed on hold during 2020, but we've taken full advantage of the expertise in the project team and the technology at hand to bring a series of webinars to the wider community.

Topics covered to date include species distribution modelling, seafloor mapping and habitat modelling, exploration of cold seep ecosystems, benthic functional diversity, and the principles of the precautionary approach.

Additionally, a wide range of research topics have been presented by the iAtlantic Fellows – our cohort of early career researchers – via the Follow the Fellow webinar series, which normally takes place on the first Wednesday afternoon each month. These sessions are an opportunity for the Fellows to introduce their research, but also to discuss related issues, approaches, dilemmas and gaps with those in the audience. The aim is to provide a friendly and constructive forum to share ideas, ask for input and stimulate collaboration – and, on several occasions, source extra data! These sessions have also provided a great way to get to know each other in the absence of the more usual networking opportunities (aka the bar after a workshop/project meeting/conference).

All the iAtlantic webinars are open and everyone is welcome, including those outside the iAtlantic partnership. Upcoming events are listed on the iAtlantic website and our webinars are normally recorded, so if you missed the main event you can catch up at your leisure!

Many thanks to all our webinar presenters during 2020 - we look forward to many more stimulating and fruitful sessions in 2021.

See website for further details...

www.iatlantic.eu/events-calendar/webinar-programme

And for archive recordings...

www.iatlantic.eu/events-calendar/iatlantic-webinar-archive/

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