



# Special Newsletter **2018**

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Strengthening pan-Atlantic Cooperation for Ocean Observing



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## What is the AtlantOS project?

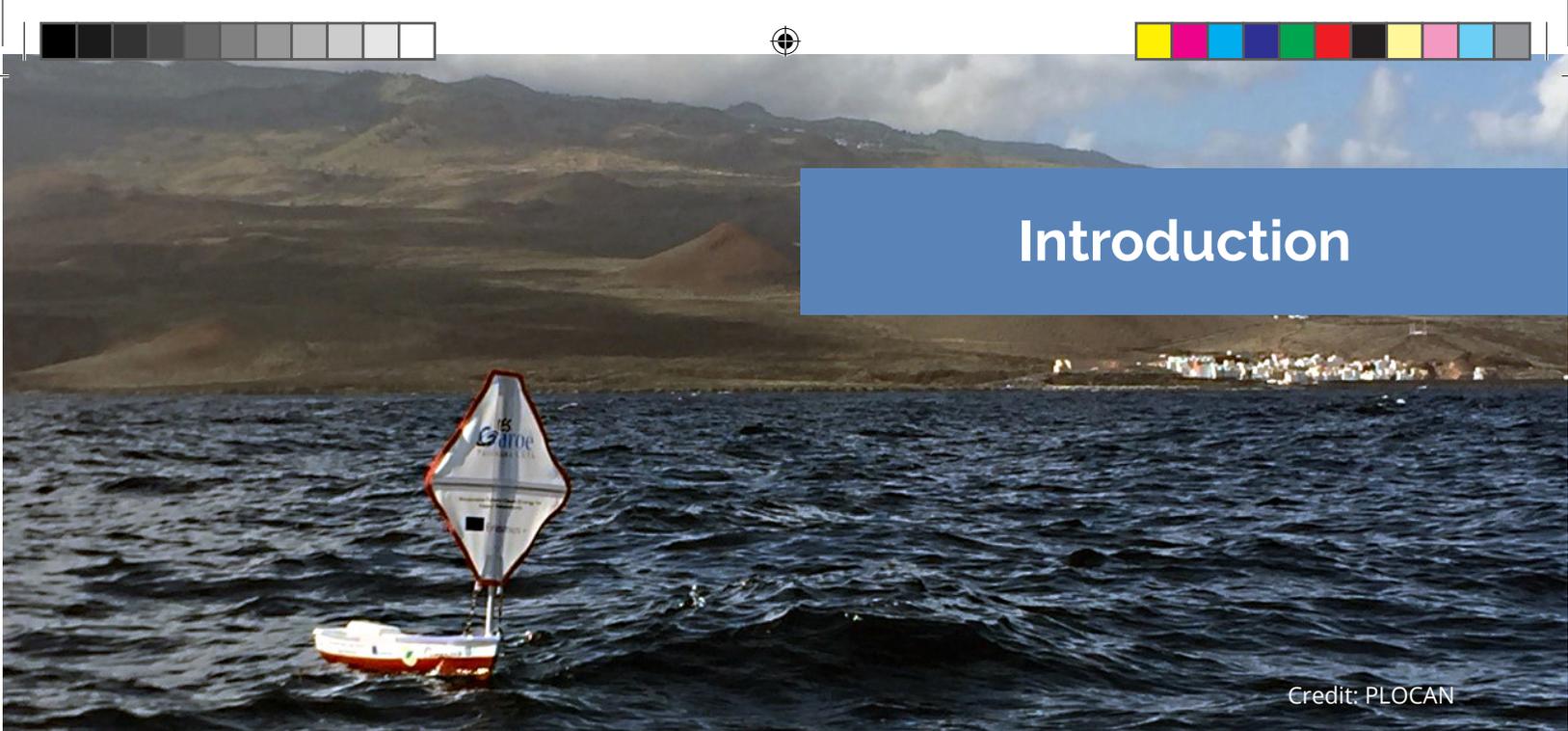
The AtlantOS H2020 EU research and innovation project pools the effort of 57 European and 5 non-European partners from 18 countries to collaborate on optimising and enhancing Atlantic Ocean observing. The project has a budget of about € 21 Million for 4 years (April 2015 – June 2019) and is coordinated by GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (Prof. Dr. Martin Visbeck).

The overarching target of the AtlantOS initiative is to deliver an advanced framework for the development of an integrated Atlantic Ocean Observing System that goes beyond the state-of-the-art, and leaves a legacy of sustainability after the life of the project.

## Credits

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## Introduction

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### Requirements and contributions – Strengthening a pan-Atlantic cooperation

Sabrina Speich (Ecole Normale Supérieure, Paris, France) and Johannes Karstensen (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)

A key aim of AtlantOS is to move ocean observing in the Atlantic Ocean from a loosely-structured, largely-fragmented collection of ocean observing activities to a coherent, effective and efficient as well as fit-for-purpose system. The value-added of such a system is that the resulting long-term and continuous data records for the whole of the Atlantic would help improve our collective understanding, monitoring, and modelling of the ocean.

For this, we need to assess the current and emerging status of observational programs and projects in the context of climate and ecosystems for the Atlantic. We need to identify the shared and common understanding of the requirements for sustained Atlantic Ocean covering stakeholders across the basin. In particular, we need to pragmatically evaluate the potential to connect ocean observing across time-limited science projects, science-driven observing systems and operational service providers and governmental agencies.

On this basis, products and services can be developed for the widest range of users, including operational service providers (e.g. weather), scientists, commercial companies as well as environmental monitoring. This goal would benefit societies around the Atlantic, but it is massively challenging.

Ocean observing is a complex end-to-end system built upon engineering, operations, data management, information products and dissemination as well as associated human capabilities. This system can only work if all named working fields are fostered over the

long term by supportive planning and governance frameworks decided on by national governments and agreed through international organizations. In AtlantOS, the aim has been to support the development of this cooperative environment, by bringing together the entire Atlantic observing community in order to assess what is being done, the strengths and weaknesses of ongoing observation activities as well as the requirements of users being served by the observing community.

To this end, AtlantOS in cooperation with the Atlantic Ocean Research Alliance support project (AORA-CSA) hosted a one-day workshop in July 2017 to focus specifically on discussing the work of the observing community in the Southern Atlantic Region and the needs of the users they serve. The focus of discussions of the partners from over six Southern Atlantic region countries as well as European and North American countries were on themes, including climate, ecosystem health and productivity as well as fisheries. This special newsletter summarizes the discussion of this meeting and provides a platform for key partners from the Southern Atlantic Region to present the work they are currently involved in as well as their contributions and expectations from a pan-Atlantic Ocean observing system.

Additionally, only three months after the signing of the Belém Statement, a workshop took place in Argentina that aimed to better connect and promote cooperation within the field of ocean observations in the South Atlantic.

# Connecting to better observe the Atlantic Ocean



Credit: Pixabay

## Summary of the workshop with partners from the South and North Atlantic on 12 of July 2017 in Lisbon, Portugal

Sabrina Speich (Ecole Normale Supérieure, Paris, France) and Michael Ott (Intergovernmental Oceanographic Commission of UNESCO, France)

The objective of this workshop was to examine the current and emerging status of observing efforts with a view to achieving, in the end, a transition from a loosely-coordinated and fragmented set of existing ocean observing activities into a system

The workshop was organized in three sections:

1. A general introduction to on-going international efforts and strategies for better framing the challenges in multidisciplinary ocean observing;
2. Presentations of on-going international observing efforts in the Atlantic Ocean (the focus was set on Climate and Ecosystems);
3. Updates of ocean observing efforts from a number of southern countries and their expectations linked to the Atlantic Ocean observing.



*Sabrina Speich and Johannes Karstensen introduced the sections of the workshop. Credit: Sabrina Speich*

that is sustained and sustainable, efficient, and fit-for-purpose.

To this end, individuals from around the Atlantic with a stake in sustained Atlantic Observing System were invited to discuss their expectations and needs. In the workshop, participants were invited to present and discuss their expectations, current thinking, strategies from respective national and institutional perspectives. The discussion will serve as a basis for a strategy paper on better networking between observing process in the North and South Atlantic.

In the first session, entitled **“A general introduction to on-going international efforts and strategies for better framing the challenges in multidisciplinary ocean observing”**, Toste Tanhua (GEOMAR, Germany) introduced to the ‘Framework for Ocean Observing’ which guides the path from the science-driven requirements resulting from societal issues, identifying the observations deployment and maintenance needed for the production of impactful and relevant tools to address those issues. Johannes Karstensen (GEOMAR, Germany) described in his presentation how ocean functioning could be described through collecting data on what have been termed the Essential Ocean Variables (EOVs); a list of approx. 30 ocean parameters that can be measured by collecting data from the oceans. Third, Brad De Young (Memorial University, Canada) introduced the ‘BluePrint for an Integrated Atlantic Ocean Observing System’, which will lay out the principles and plans for sustained ocean



observations in the North and South Atlantic, and is contributing to an application of the 'Framework for Ocean Observing' to the Atlantic Ocean. The BluePrint was initiated and is supported by the EU-funded AtlantOS project, but is seeking input from the whole Atlantic Ocean community.

The subsequent roundtable discussion identified the following key issues:

1. An increase in data sharing would be widely welcomed, provided it supports local scientific and societal needs;
2. Within the Exclusive Economic Zones (EEZ), data collection and sharing, especially on biogeochemistry and biology, should be improved to support both a better understanding of coastal phenomena and as a means to building local capacities. To this end, joint cruises and ship-based training were mentioned;
3. The Belem and Galway Statements provide frameworks in which collaboration and help overcome at least some barriers – key benefits being optimization/consistency/integration of observing efforts and sharing infrastructure (including ship-time) and expertise.

The second session, entitled **“On-going international observing efforts (with focus on Climate and Ecosystems) in the Atlantic Ocean”**, began with seven presentations by Brian King (NOC, UK), Bernard Bourles (IRD, LEGOS, France), Pedro Monteiro (CSIR, South Africa), Peter Brandt (GEOMAR, Germany), Maria Paz Chidichimo (CONICET – SHN, Argentina), Mark Dickey-Collas (ICES, Denmark) as well as Doug Connelly and Richard Lampitt (NOC, UK) who described the potential of different observing projects and within different research fields.

In the roundtable discussion, key issues raised included:

1. The lack of (even physical) data in certain areas and timescales, such as boundary currents in the upper-slope and shelves to close budgets;
2. The need for data to be used (preferably through client pull, which requires user involvement in observation design) to ensure sustainability of observational programmes;
3. The need for and increasing possibility to integrate various sensors on single platforms; and
4. The need for scientists and users to better articulate the benefits of ocean knowledge (not ocean observing directly) for socioeconomic benefits.

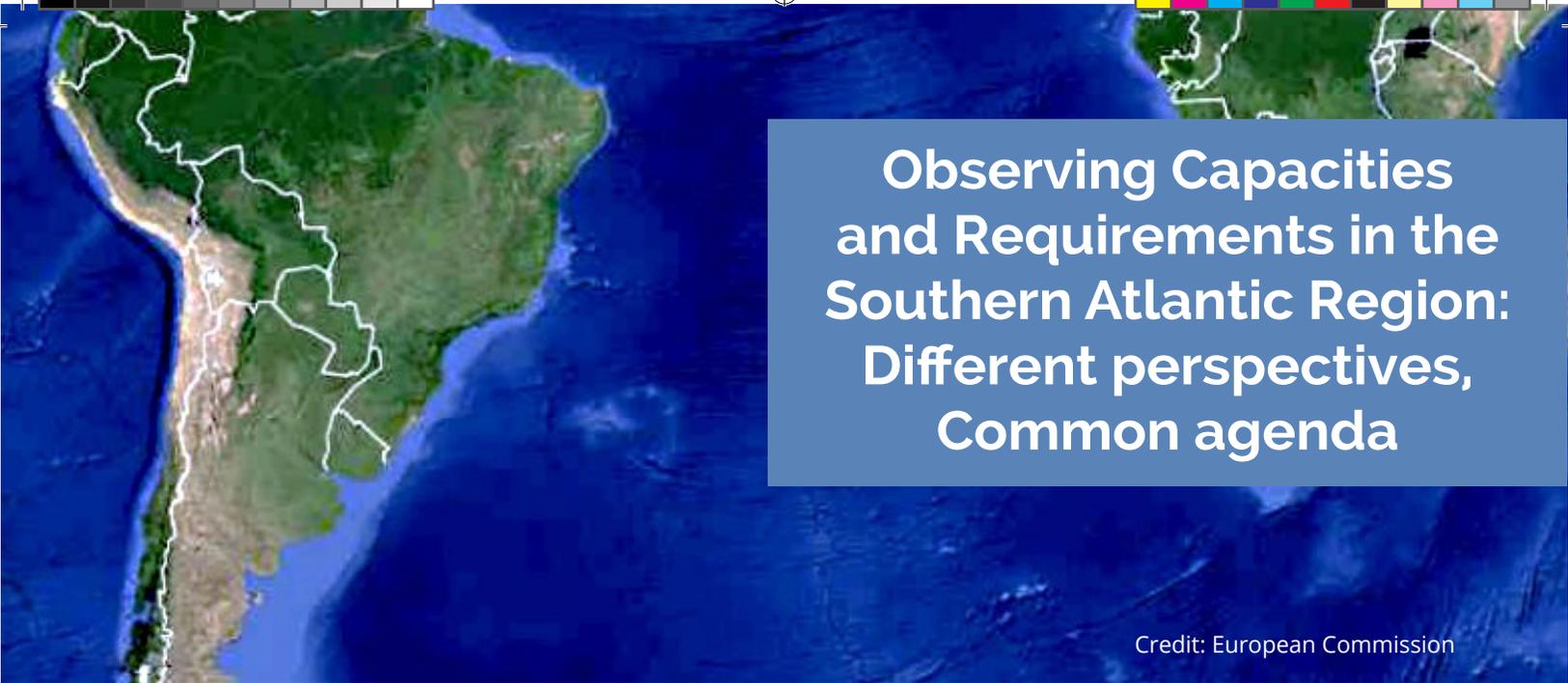
In the last session, entitled **“Updates of ocean observing efforts from a number of southern nations and their expectations linked to the Atlantic Ocean observing”**, seven South Atlantic

countries highlighted some successes and challenges of their national programs, as well as expectations for the Belem and AtlantOS initiatives. Presentations were held by Vito Ramos (INDP, Cape Verde), Francis Emile Asuquo (University of Calabar, Nigeria) and Nsikak Benson (Convenant University, Nigeria), Mthuthuzeli Gulekana (Dept. of Environment, South Africa), Filomena Vaz Velho, (National Fishery Research Institute of Angola), Samuel Mafwila (Sam Nujoma Marine and Coastal Resources Research Centre, University of Namibia), Maria Paz Chidichimo (National Scientific and Technical Research Council – Servicio de Hidrografía Naval, Argentina) as well as Andrei Polijack (Ministry of Science, Technology, Innovation and Communication, Brazil).

In the discussions that concluded this session and the workshop day, the following points were raised:

1. Countries owning new or operating research are looking to share ship time and other observing infrastructure as well as for collaborative observation efforts.
2. Although an increasing number of national marine institutes recently had been, or were about to be, established, there remains in many countries around the Atlantic a lack of technical capacity as well as public and government understanding of the potential benefits of ocean information made it difficult to integrate smaller-scale (university-level) programs and develop more robust and general national observing programs.
3. There was an understanding that even where data were being collected, they were not being used to their full potential. In this context it was noted that regional data sharing (e.g. between the individual monitoring lines in Angola, Namibia, and South Africa) could benefit all.
4. The South-South Plan and the Belem Agreement were seen as a framework to increase regional cooperation.
5. In addition, to increase collaboration and harmonizing data collection among regional players, other expectations from the Belem and AtlantOS initiatives included: capacity building and incorporating new technology, sharing resources (including those of the Southern Atlantic nations, such as ship-time), inserting of national programs into international alliances, contribution to international science as well as improved understanding of national areas of interest, enhancing monitoring in boundary and coastal areas and of biology / ecosystem variables, and encouraging political leaders to move towards more agreement in areas such as data sharing.





# Observing Capacities and Requirements in the Southern Atlantic Region: Different perspectives, Common agenda

Credit: European Commission

## The Perspective from Angola

Pedro Tchicalanga and Filomena Vaz Velho (National Institute for Fisheries Research, Angola)

Angola is located at the Atlantic coast in Southwestern Africa between 5°S and 17°20'S with borders to Democratic Republic of Congo in the north and to Namibia in the south. Its coastline stretches over a distance of 1600 km, with a continental shelf of 51000 km<sup>2</sup>. The coastal area of Angola is influenced by the Benguela cold current in the southern part of the country and the Angola warm current in the northern and central part. The two currents meet at around 15°S, dividing the Angolan maritime waters into two distinct ecosystems, a temperate and a tropical one separated by a transition zone located in the southern region of the country. This makes the Angolan Exclusive Economic Zone (EEZ) very rich in fisheries resources. However, in order to secure the economic and social beneficial development of these resources, exploitation needs to be based on the based available data and analyses.

The Angolan Law of Aquatic Resources in its article stated the need to utilize living marine resources on the basis of sustainability for benefit of the nation aiming to optimize the economic and social benefits from the marine resources and to maintain the long-term biological sustainability of the stock(s) exploited.

### Marine Research History

After independence in 1975, some sporadic research surveys took place by Cuban and Union of Soviet Socialist Republics (USSR) research vessels aiming to monitor the main fishing resources. In the early 80's the Angolan Ministry of Fishery signed an agreement with the Swedish International Cooperation Agency (SIDA) to, among others, rebuild the Research Vessel

(RV) GOA and thereby fulfilling the growing demand of Angolan marine researchers. During the surveys carried out by RV GOA fishing trawls were always complemented by CTD (conductivity, temperature, depth) stations collecting physical parameters as well.

Since the mid-eighties, Norway has been supported the development of the Angolan fisheries sector. Starting with the Nansen program, the overall objective was to strengthen technical, managerial and scientific capacities in prioritized areas in order to promote ecological and environmental sustainable aquatic resource utilization as well as a viable economic fisheries sector development in Angola. Surveys with the RV Dr. Fridtjof Nansen were first conducted in 1985. A systematic study covering the shelf of southern Angola started in 1994 with two cruises annually, in February/March and July/August, covering the entire extent of the Angolan continental shelf.

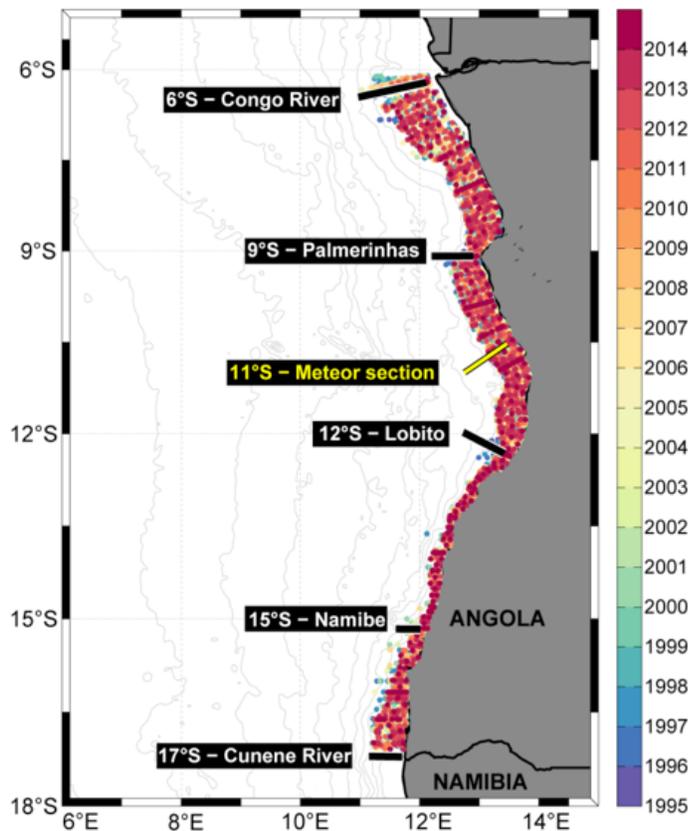
The Nansen time-series is the backbone of the fisheries management in Angola and has become a strong tool for implementing important regulation measures to protect and rebuild the fish stocks and ecosystem. Besides of fishery data during the surveys the following environmental data are registered at all trawl stations.

### Meteorological and hydrographic sampling

Meteorological data including wind direction and speed, air temperature, global radiation and sea surface temperature (SST) were automatically logged every nautical mile using an Aanderaa meteorological station.

### ADCP current measurements

A shipboard Acoustic Doppler Current Profiler (ADCP) from RD Instruments continuously measured ocean currents along the cruise track during all cruises since 2005. These data have been analyzed recently by and submitted by P. Tchikalanga et al to the Bulletin of the American Meteorological Society.



**Figure 1** Benefit by implementing a regional collaboration between Angola, Namibia and South Africa (BENEFIT program): Monitoring lines to collect physical, chemical, and plankton data.



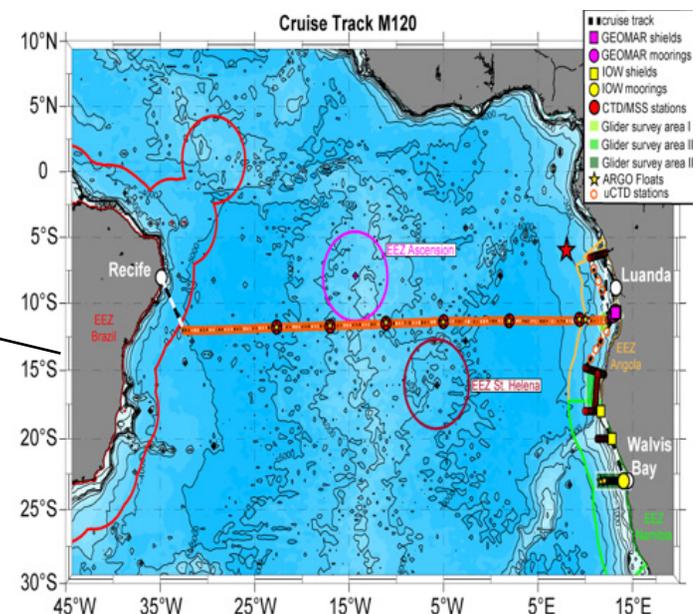
### Conductivity, salinity, and oxygen measurements

A Seabird 911 + CTD probe was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging is done using the customized Seabird Sea save software installed on a PC.

With the implementation of a regional cooperation among Angola, Namibia and South Africa in the frame of the BENEFIT (Benguela Environment Fisheries Interaction & Training, 1999-2009) program, six monitoring lines were established (Figure 1) to collect physical, chemical, and plankton data.

Under the institutional agreement signed with the Baltic Sea Research Institute Warnemuende and the Leibniz Centre for Tropical Marine Research (ZMT) several research cruises with German RV Maria S. Merian and Meteor were carried out dedicated to perform oceanographic research.

More recently in the frame of the EU PREFACE (Enhancing prediction of Tropical Atlantic climate and its impacts, 2013-2017) project a close collaboration was established with the Helmholtz Centre for Ocean Research Kiel (GEOMAR) aiming at investigating the ocean temperature and salinity variability as well as tropical Atlantic circulation and its seasonal to inter-annual variability. Within this collaboration, three cruises were carried out in June 2013, October 2015 and 2016 that started in Brazil and ended in Namibia (see Figure 2). The oceanographic expeditions provided valuable information on hydrography, currents and mixing from the Angolan continental slope and shelf including the first direct velocity observations from



**Figure 2** Cruise track from one of three cruises caused through the EU PREFACE project (2013 - 2017).

moorings in the Angola Current.

Within the Angolan environmental monitoring program, three fixed oceanographic stations are maintained in the three main coast provinces, Luanda, Lobito and Moçâmedes - named Namibia. As the Harmful Algal Blooms (HABs) are a national concern because they affect not only the health of people and marine ecosystems, but also the 'health' of local and regional economies, since 2000 a fixed oceanographic station was implemented near Luanda in the frame of the HABs program.

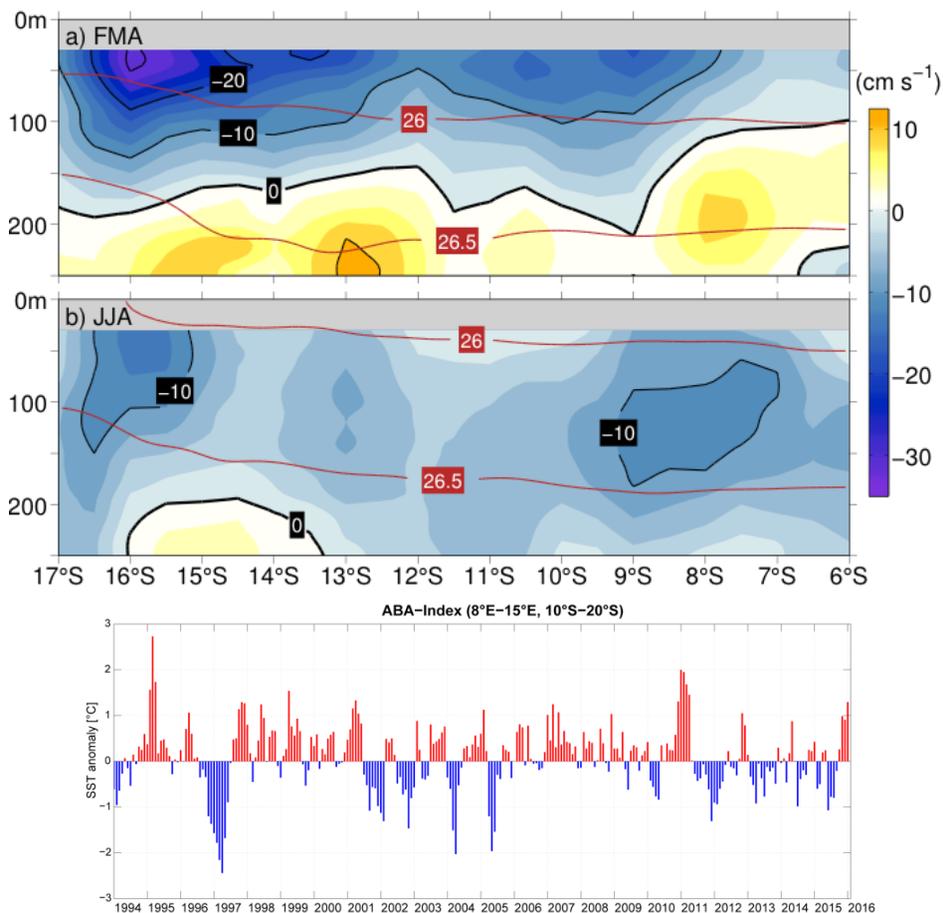
The data acquired so far has allowed a detailed description of the large-scale eastern boundary circulation off Angola that characterizes the main downwelling and upwelling periods (Figure 3), including its impact on fishery activity.

Such results, which reflect the effect of climate variability and change, are nowadays disseminated to managers and decision-makers to be taken into account when evaluating long-term changes in fisheries and the livelihood of fishing communities.

### Infrastructure capability

In 2012, a mid-sized research vessel (28 meters) RV Pensador has been delivered that is equipped with a CTD-system and a multi-net for plankton research. The Angolan Government saw the need to further develop the ecosystem approach to the management of fisheries and the marine environment. In 2014, the Angolan government decided to build a fisheries and oceanographic research vessel, the delivery of which is expected in July 2018. The new research vessel will perform resource monitoring, oceanographic and environmental surveys, ecosystem investigations, bottom habitat mapping, pelagic and demersal trawling, CTD measurements, single and multi-beam echo-sounder surveys, integrated data logging.

Training of Angolan scientists still plays a key role for strengthening the technical skills required to do valuable oceanography research. During the conducted cruises with the RV Dr. Fridtjof Nansen and RV Meteor the participating scientist were trained to operate oceanographic instrumentation. However, the further development of Angolan oceanographic research requires establishing a proper training strategy, which will be achieved also by strengthening the collaboration with Brazil.



**Figure 3:** Sub-surface temperature showing the existence of warm and cold anomalies in the upper thermocline that have similarities, but also discrepancies with SSTA anomalies in Angolan waters. Kopte, R. et al., *Journal of Geophysical Research: Oceans*, 2017 (submitted by P. Tchipalanga et al. to the *Bulletin of the American Meteorological Society*)



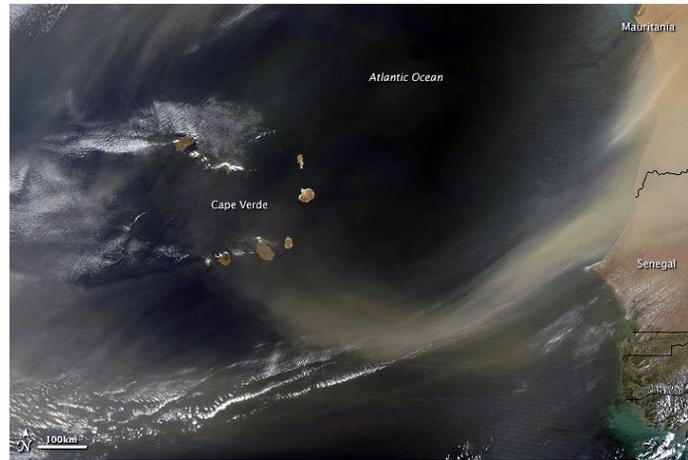
# The Perspective from Cape Verde

Vito Ramos (National Institute of Fisheries Development (INDP), Cape Verde)

The tropical zone of the Eastern Atlantic, where Cape Verde is situated, was, until recently, largely unknown to the non-scientific community in terms of its importance for studies of global importance in the field of oceanography, the interactions between the atmosphere and the sea, etc. We can even say that the knowledge about the consequences of climate change arising from the interactions between the sea, the earth and the atmosphere is scarce, especially in this part of the globe, where such processes are very dynamic.

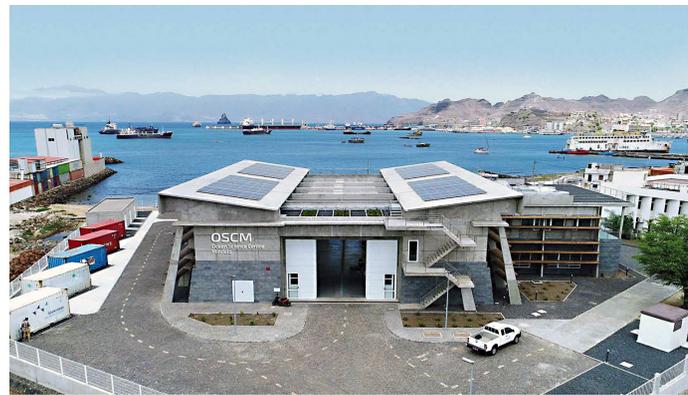
We can highlight major atmospheric and oceanographic phenomena in this tropical zone, such as the formation of tropical cyclones, the great upwelling zone of Mauritania, the deposition of dust from the Sahara Desert, the Oxygen Minimum Zone (OMZ), the monsoon system with lots of rain, the emission of halogenated trace gases, the formation of submarine banks by the volcanic activity (hotspot), with physical, biochemical consequences and on the oscillation of living resources at a local and global level.

Given the interest of the scientific community in the tropical Atlantic zone, a workshop entitled "Towards a West African Logistic Center in Cape Verde" was held in Mindelo in 2004, with the participation of institutions and researchers from around the world. This meeting established the TENATSO project (Tropical Eastern North Atlantic Time Series) as a cooperative effort between institutions from Germany, England and Cape Verde. The project consisted of the creation of two observatories in Cape Verde, one atmospheric (CVAO-Cape Verde Atmospheric Observatory) and one oceanographic (CVOO-Cape Verde Ocean Observatory), with the purpose of establishing a systematic and permanent monitoring of atmospheric and oceanic parameters in the Eastern Atlantic, and thus to contribute with long-term data to major global scientific programs to better understand the interactions between the atmosphere, the hydrosphere and the biosphere. In the last ten years, several works have been developed and published together, related to the different subjects.



*Dust plumes off Western Africa. Credit: NASA.*

Taking into account the importance of the area as a natural laboratory for different experiences and scientific campaigns would then have the need to create special logistic conditions for the use of the local, regional and global scientific community. With this in mind, the Ocean Science Center of Mindelo (OSCM) has been built, equipped with several laboratories, offices, conference rooms, a ship and technical-scientific staff to support any experience, expedition or campaign in the area. In this way, we intend to participate and contribute to the AtlantOS project with our experiences, our time series observatories and logistics centers and thus integrate knowledge throughout the Atlantic.



*Ocean Science Center of Mindelo (OSCM). Credit: Edson Silva Delgado.*



## The Perspective from Namibia

Sam Mafwila and Sam Nujoma (Marine and Coastal Resources Research Centre, University of Namibia, Henties Bay, Namibia)

Namibia is strategically located on the eastern boundary of the South Atlantic Ocean between South Africa on the southern border and Angola on the northern border. The three countries have a regional body called the Benguela Current Commission, which plays a pivot role in terms of coordinated effort to support the three governments in research and sustainable management of the resources of the Benguela Current Large Marine Ecosystem.

Ocean observations and monitoring has been a cornerstone for informed decision-making processes and good ocean governance in Namibia. There are good legislations, policies, and regulations in place to support the coordinated utilization of the marine resources of Namibia. The Ministry of Fisheries and Marine Resources (MFMR) through the National Marine Information and Research Centre (NatMIRC) in Swakopmund have been the leading governmental institutions in terms of stock biomass assessments and marine environment monitoring. Furthermore, the University of Namibia through the Sam Nujoma Marine and Coastal Resources Research Centre (SANUMARC), and the Department of Fisheries and Aquatic Sciences in Henties Bay have been involved in marine research and producing graduates in marine sciences. The National Commission on Research, Science and Technology (NCRST) amongst others, funds and promotes research in Namibia, thus creating a conducive environment for conducting research. National efforts in Ocean Observations dates way back in time, and time-series data is available in the national databases of the Ministry of Fisheries and Marine Resources, with access controlled by "permission to use".

With our participation in the AtlantOS project, the following requirements could be addressed:

- Strengthening of the South – South cooperation in the Atlantic.
- Increased participation in the North – South Atlantic Ocean research activities.
- Strengthening of the existing ocean observations initiatives within the EEZ and outside national jurisdiction. Monitoring lines could be increased to yield high-resolution data.
- Deployment of Argo floats, gliders, moored buoys and the use of ships of opportunity to install monitoring equipment for plankton, sea surface temperature, pH, DO, and salinity.
- Monitoring of migration of marine organisms, i.e. commercial fish species and shared stocks, through the ocean tracking system by deployment of receivers and supporting array of acoustic equipment on the seafloor.
- Capacity Development in the field of data management and analysis as well as instrumentation technicians.
- Harmonization of data sharing policies among the countries.
- Political buy-in is highly needed.
- Ship-time, scientific personnel and time-series data as a contribution to AtlantOS.



*RV Mirabilis: Namibia's recently acquired research vessel, and part of the three vessels belonging to the Ministry of Fisheries and Marine Resources. Credit: UNAM.*

# The Perspective from Nigeria

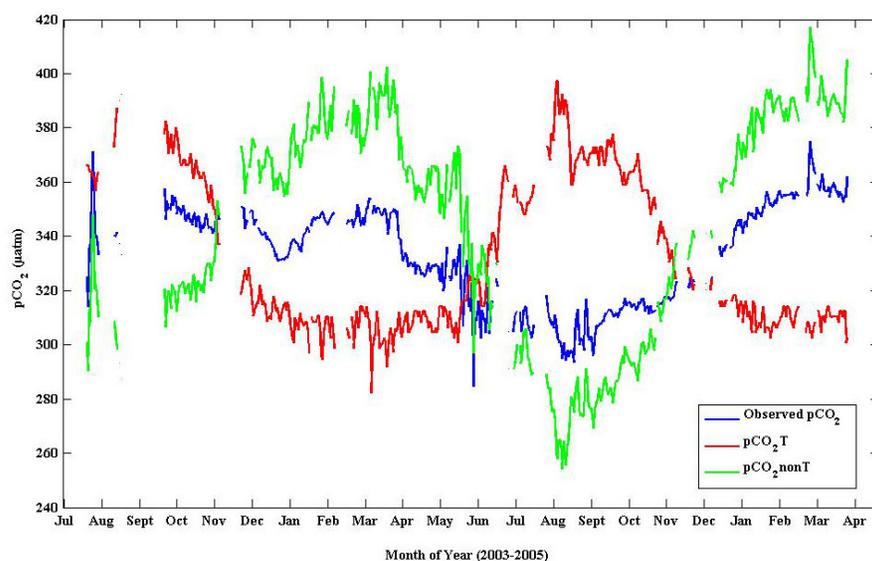
Nsikak U. Benson (Covenant University, Nigeria) and Francis E. Asuquo (University of Calabar, Nigeria)

The Nigeria's Atlantic coastline (ca. 850 km long) has been severely impacted by anthropogenic activities as well as the effects of global climate change over the years. Presently, scientific data and information from the vulnerable coastline is sparse. Given the multidimensional vulnerability status of our coastline, understanding of regional assessment of air-ocean flux of CO<sub>2</sub> and other long-lived radiative gases in the Gulf of Guinea through integrated ocean observations is our overarching goal. In addition, we need to understand the inter-annual and decadal variations in the sea-air exchanges of dimethyl sulfide (DMS) and dimethylsulfoniopropionate (DMSP) using vapour generation chemiluminescence detection technique (VG-CL), and importantly the essential ocean variables, current patterns and climate characteristics of the equatorial Atlantic Ocean using ocean gliders.

Field measurements of DMS and DMSP have begun. Understanding the emissions, chemical marine contamination and impacts of trihalomethanes and other toxic byproducts in treated seawater on marine ecosystems, human health and atmospheric chemistry has been also prioritized.

For a joint initiative, we will be willing to contribute scientific expertise (scientists and technologists) and basic facilities such as office and laboratory space for a continuous time series data acquisition in this region. Ongoing measurements will be the first datasets from our region, and will add important information to the global dataset.

Below is an excerpt of our work in the North Atlantic Ocean:



**Figure 4:** Benson, N.U. & Asuquo, F.E. (2016) Modelling the spatial and temporal pCO<sub>2</sub> variability at 49.0°N / 16.5°W and 56.5°N / 52.6°W in the North Atlantic Ocean, *Journal of Earth Science and Climate Change*, 7:330. doi:10.4172/2157-7617.1000330.

## The perspective from Brazil

Moacyr Araujo (Federal University of Pernambuco, Brazil)

In contrast to the Pacific Ocean, the climate variation in the Atlantic basin is influenced by two main modes of sea surface temperature (SST) variability. The zonal mode, which is related to the ocean adjustment into the Eastern Equatorial Atlantic to changes in trade winds in the central basin, is similar to the dominant El Niño oscillation in the equatorial Pacific. The second important mode of variability in the Atlantic Ocean, with no similar counterpart in the Pacific, is characterized by an anomalous meridional SST gradient due to a north-south oscillation in sea surface temperatures as response to the meridional displacement and intensity of the Intertropical Convergence Zone. Furthermore, the global conveyor belt in the Atlantic has a well-marked meridional basin-wide circulation, connecting the deep-water formation sites at high latitudes with upwelling lower latitude areas. In the South Atlantic, for example, salty and warmer Indian waters that flows through Agulhas leakage cross the ocean until the western boundary and follows along a large extension of the Brazilian shoreline before being transported to tropical-subtropical north Atlantic. Thus, the interaction between the hemispheres is naturally focused on the western Atlantic boundary.

Although the variation of these meridional systems has strong impact on climate variability and marine ecosystems, very little is known about how these signals cross the equator and about the variability of the warm and cold waters route in the southern hemisphere. Having in mind the need of filling these important scientific gaps Brazil has been committed and participating (since the beginning) of the main international long-term observing efforts in tropical and south Atlantic, like PIRATA, SAMBA-SAMOC, MOVAR and RACE-11oS arrays. These joint initiatives shall be maintained/enhanced and Brazil is available to keep contributing for improving tropical-south ocean observing systems and to promote scientific cooperation as key components for achieving the Sustainable Development Goals.



*Moacyr Araujo presenting the international long-term efforts made by PIRATA at the meeting 'A New Era Of Blue Enlightenment' in Lisbon in July 2017. Credit: European Commission.*

As foreseen by the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and the Southern Oceans, co-lead by Brazil and South Africa, there is a recommendation on leveraging ongoing initiatives optimizing observational systems such as PIRATA, SAMOC and MOVAR and also enhancing our capacities in the South. Some challenges have been identified, including the extension of the SAMBA line; consider the strategic positioning of Atlantic islands by establishing a network of ocean observatories and research sites in Azores, Madeira, Canary Islands, Fernando Noronha and S. Pedro-S. Paulo, in Brazil, Cape Verde, Nigeria, South Africa, as well as and others to follow; strengthen the array including new sensors and instruments. With those collaborative opportunities in hand, the knowledge gap that currently exists in the South Atlantic would then be better managed.

# Where are we going?

Credit: Pixabay

## BluePrint towards an Integrated Atlantic Ocean Observation System

Brad de Young (Memorial University, Canada) and Sandra Ketelhake (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)

The BluePrint for Ocean Observing in the Atlantic is a strategic document that outlines the elements necessary for a more sustainable, coordinated and comprehensive ocean observing system delivering relevant ocean information for a wide range of societal benefit areas spanning ocean change, near-real-time ocean state estimation. Such an observing system should support sustainable ocean use in the North and South Atlantic.

The BluePrint Team started the writing process with meetings on the sidelines of the UN Oceans Conference in New York City (June 2017) and the New Era of Blue Enlightenment conference in Lisbon (July 2017). The Lisbon meeting was a good opportunity to enhance the links between partners from the North and South Atlantic. The Team has agreed to develop two related documents that will be written at the same time: A shorter "vision document" and a longer, more detailed "implementation plan".

Relevant materials that the team members are working from include the Framework of Ocean Observing 2012 and the Tropical Pacific Observing System 2020.

The BluePrint documents were shared with the AtlantOS community in November 2017 and made available to other interested reviewers upon request. In early 2018, the first public draft of the vision document will be openly released for further comments and feedback. In summer 2018, a first public draft of the implementation plan will be released for comments and feedback.

The BluePrint will benefit from active engagement from all interested parties and partners. Thus, the team welcomes your input and engagement. For comments and suggestions, please visit the BluePrint website: <http://atlanticblueprint.net/>.



Part of the BluePrint Team at the meeting in Lisbon in June 2017. Credit: Martin Visbeck.

# Notes from the EU-Argentina workshop in Buenos Aires in November 2017

Alberto Piola (University of Buenos Aires, Argentina)

The South Atlantic Ocean is the pathway of all major water masses participating in the global meridional overturning, which acts to redistribute heat on Earth and to store greenhouse gases in the deep ocean. Therefore, the South Atlantic is a key component of the climate system.

Along the southern edge of the subtropical gyre, the warm subtropical and cold sub-Antarctic waters flow east separated by sharp zonal fronts. These fronts act as barriers and blenders of the distinct water masses. In addition, the surface winds control the amount of sub-Antarctic waters that sub-duct along the fronts and modulate the sign and intensity of the air-sea heat and freshwater exchange.

The northern margin of the subtropical gyre is connected to the South Atlantic tropical gyre, in what has been named the subtropical cell. The central and intermediate waters flow westward along the northern edge of the subtropical gyre, bifurcating at the coast of Brazil into the southward flowing Brazil Current and the northward flowing North Brazil Current. The latter is a key element of the Atlantic meridional overturning.

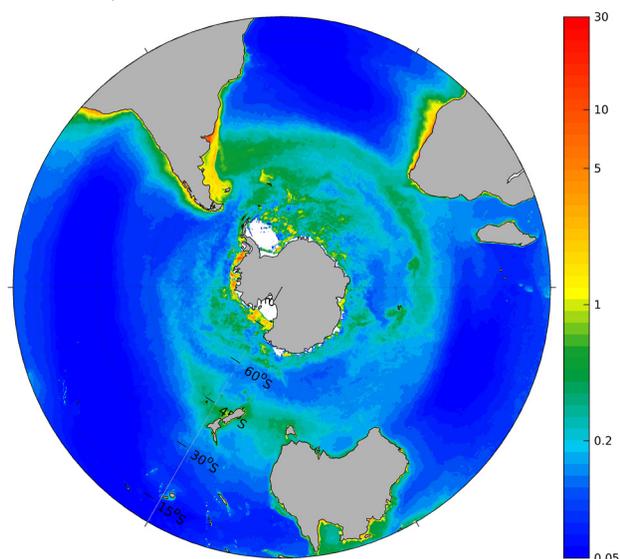
The transition of subtropical to subpolar waters in the South Atlantic presents significantly higher surface chlorophyll concentrations than the Indian and Pacific counterparts, suggesting a higher nutrient availability. Within the South Atlantic, it is the Patagonia continental shelf, which stands out as the most productive region, while in the deep ocean the Brazil/Malvinas Confluence stands out as high productivity domain, associated with outstanding mesoscale variability. The shelf high chlorophyll regions are associated with high absorption of atmospheric CO<sub>2</sub>, indicating a substantial contribution from the so-called biological pump. However, there is still a limited understanding of the processes that sustain the high chlorophyll concentration trough eddies, filaments and frontal currents in the region. Improved knowledge of the large and mesoscale circulation and as well as the biogeochemical interactions that take place in the South Atlantic Ocean and their evolution are required to further understand the mechanisms that control Earth climate, and the ability to predict its future evolution.

A workshop was carried out in Buenos Aires, Argentina on the 23rd of November 2017 to foster the cooperation among marine scientists and

institutions from Argentina and the EU. The aim of the workshop was to identify knowledge gaps and cooperation strengths and opportunities for collaboration on South Atlantic research in the short and medium terms. Given the breath and global significance of the South Atlantic, international cooperation is the only practical way to tackle the challenging problems that currently limit our ability to predict the evolution of this unique ecosystem under global change and its feedbacks to the evolution of global climate.

The Buenos Aires Workshop specifically identified the need to better understand in the Southern Atlantic:

- the intensity of the AMOC at the key border paths between the subtropical and tropical gyres.
- the role of South Atlantic frontal areas in the dynamics and biodiversity of plankton, and how these determine the geographic and seasonal patterns in productivity.
- past and present patterns that influence the evolution of deep-sea ecosystems, including models of the dispersal of benthic and pelagic organisms under present and future climate scenarios.
- large-scale oceanographic patterns that favour biological connectivity, both zonally across the basin and meridionally between subantarctic and tropical waters.



**Figure 6:** The map shows the climatology of surface chlorophyll-a in the southern hemisphere from 2015 to 2017. Credit: NASA's Visible Infrared Imaging Radiometer Suite - VIIRS).

# News from the community

■ At the Ocean Sciences Meeting (11 – 16 February 2018) in Portland (Oregon, USA) the following Town Hall Meetings are organized or co-organized by members of the AtlantOS community:

- Ocean Applications for Societal Benefit from Observations and Models (Monday, February 12, 2018, 06:30 PM - 07:30 PM, Oregon Convention Center, E141-E142),
- Framework for Ocean Observing: Community Review of Next Steps in Preparation for OceanObs '19 (Tuesday, February 13, 2018, 06:30 PM - 07:30 PM, F150),
- Partnership building to advance the integrated global in-situ Ocean Observing Systems (Wednesday, February 14, 2018, 12:45 PM - 01:45 PM, F151),
- Managing the Evolution and Sustainability of Best Practices Across Ocean Science (Wednesday, February 14, 2018, 12:45 PM - 01:45 PM, E143-E144),
- Group on Earth Observations (GEO) Town Hall: Ocean science-related GEO Initiatives (Wednesday, February 14, 2018, 06:30 PM - 07:30 PM, E143-E144),
- From 27th to 30th September 2018 the EU Commissioner for Research, Science and Innovation, Carlos Moedas, will be visiting the Republic of Cabo Verde to strengthen and support the cooperation in ocean sciences.

■ The Directorate-General for Research and Innovation encouraged the scientists on Cabo Verde to strongly cooperate with the consortium of the H2020 Blue Growth South Atlantic Coordination & Support Action (CSA) as part of the 'All Atlantic Ocean Research Alliance Flagship' to promote the Belém Statement signed by the EU, South Africa and Brazil in July 2017. The University of Cabo Verde and the Ocean Science Centre of Mindelo, run by GEOMAR and INDP (National Institute of Fisheries Development of Cabo Verde), shall play a crucial role in intensifying the collaboration in the South Atlantic.



# AtlantOS

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