

To be distributed at the
2nd High-Level Industry-Science-Government Dialogue
on Atlantic Interactions, Florianópolis, Brasil,
20-21 November, 2017

ATLANTIC INTERACTIONS

NOVEMBER 2017

A PROCESS OF SCIENTIFIC DIPLOMACY:
JUNE 2016 - NOVEMBER 2017

Integrating Space, Climate, Oceans and Data Sciences
through North-South / South-North Cooperation

Towards the
Atlantic International Research Center (AIR Center)



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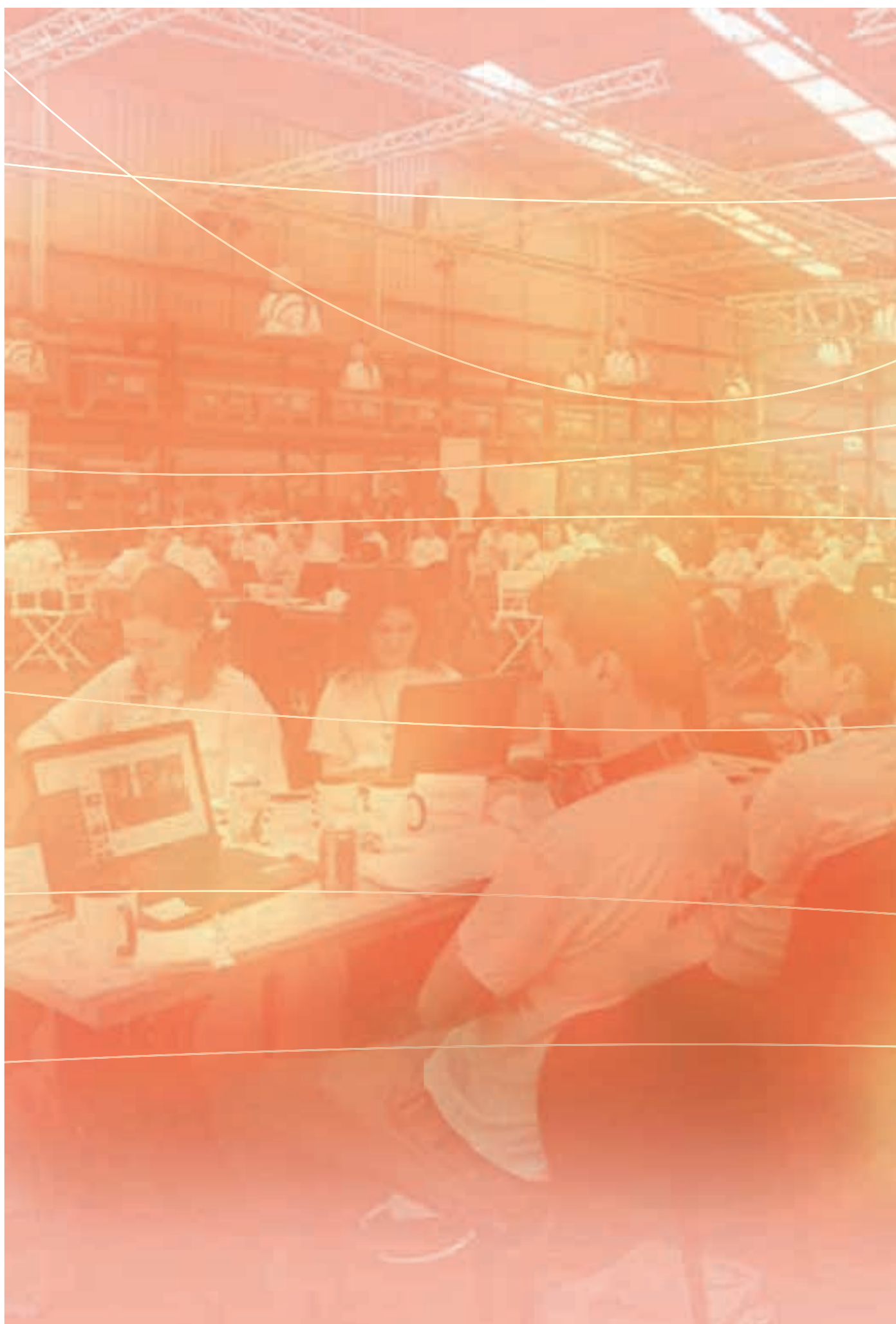
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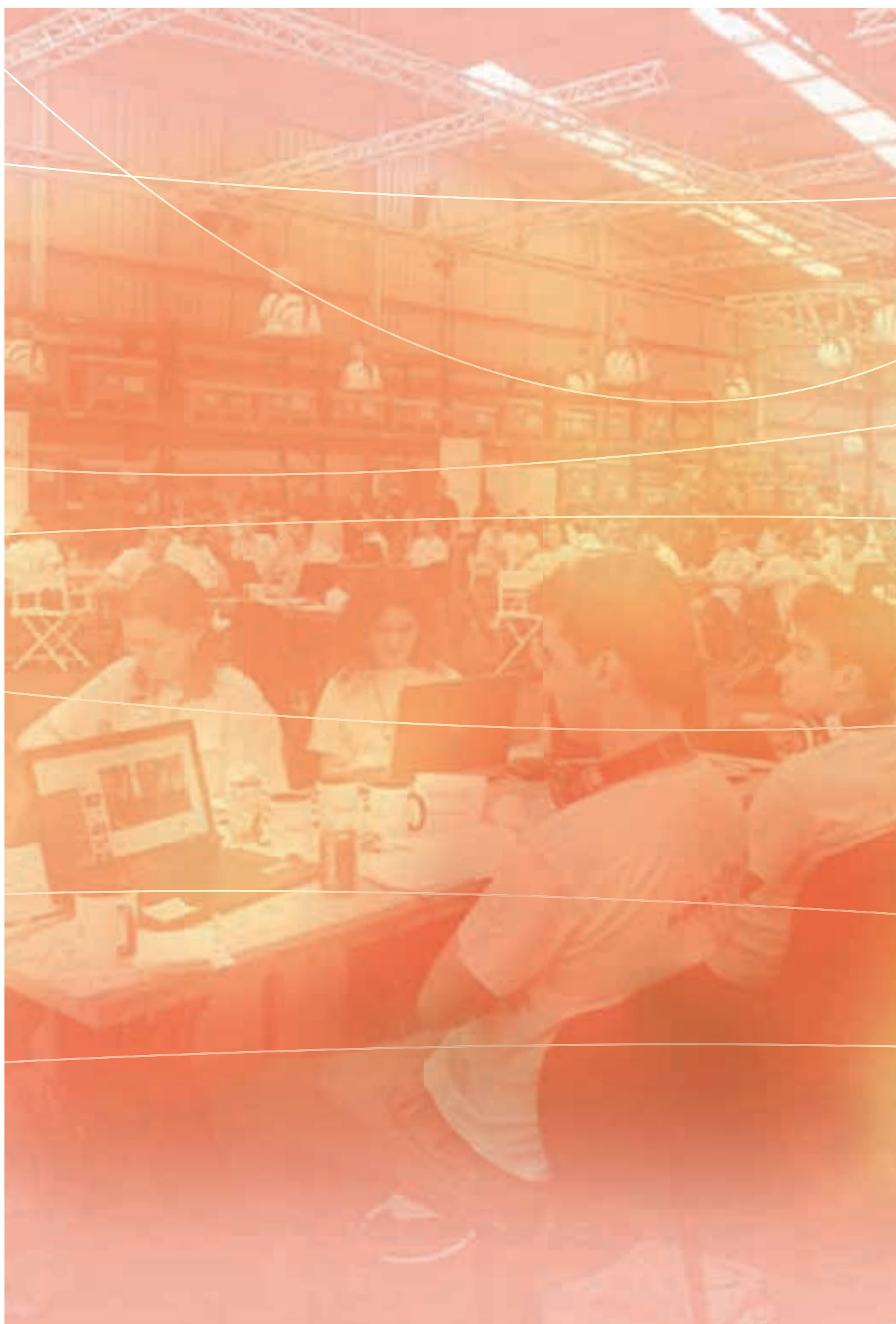
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Atlantic Interactions: a commitment to knowledge through global science and technology cooperation and science diplomacy

Manuel Heitor

Minister for Science, Technology and Higher Education, Portugal

The preparation of the agenda Atlantic Interactions has been associated with an open and new debate about multilateral cooperation in complex systems engineering and science towards an integrative approach to space, climate-energy and oceans sciences in the Atlantic, together with emerging methods of data science management. The ultimate goal is to help building the future through an effective commitment to knowledge through global and north-south / south-north cooperation.

We are entering critical times that require the creation of conditions for the strengthening of knowledge-based international cooperation. Lessons learned over the last decades with international partnerships in science, technology and higher education, including those established over the last decades between Portuguese and US Universities, among many other Intergovernmental scientific ventures, have clearly shown that the future can only be built based on an exchanged of solid knowledge, skills and ideas.

A new paradigm of structured international research relationships is emerging, which is shaped by a new era of Government and Industry intervention in association with scientific knowledge. Cross-disciplinary new frontier research should be the result of ambitious initiatives yet to be stimulated and developed from the huge potential of Intergovernmental research laboratories and joint ventures. It is under this context that the debate of the potential installation of an Atlantic International Research Center (AIR Centre) is focused on. This debate is centered under two main priorities: i) new data collection for innovative research; and ii) space, climate, oceans and data sciences synergies towards new knowledge production and diffusion.

Our ambition is driven by an increased perception by society of the growing evidence for the potential benefits resulting from the human, social and economic appropriation of the results and methods of science. We aim to stimulate the necessary knowledge-driven conditions to build an Intergovernmental research center with strong international cooperation, taking advantage of the strategic positioning of Atlantic islands by establishing a network of research sites in Azores, Madeira, Canary Islands, Fernando Noronha and S. Pedro-S. Paulo, in Brazil, Cape Verde, as well as in others to follow, thus increasing operational efficiencies by optimising the appropriate use and sharing of research infrastructures, and access to and management of data and platforms. By promoting new knowledge on climate change and related issues in the Atlantic, we are fostering conditions to provide the world with more science, more knowledge and more scientific culture.

The exceptional position of Azores and other Atlantic islands stimulates the access to new frontiers of knowledge, together with the development of new space and marine industries. For example, facilitating the access to Space from the unique position of the Azores, promoting access to new frontiers of knowledge, together with the development of new space industries, should be promoted in coming years to entrepreneurs worldwide. Also, by promoting new research in the deep-sea of Azores and in other Atlantic regions we facilitate the access to a better understanding of living organisms in extreme environments and also of non-living resources.

Moving towards the goal of sustainability requires fundamental changes in human behavior as well as more knowledge and more scientific culture, ensuring the access to science and education as an inalienable right of all. More science and the systematic democratization of access to knowledge mean more equal opportunities, more social mobility and a new stimulus for entrepreneurial activities and well-being.



The Atlantic Ocean is central to the economies

Gilberto Kassab

State Minister of Science, Technology, Inovations and Communications, Brazil

The Atlantic Ocean is central to the economies of its bordering nations and essential for global aspects such as climate, fisheries, agriculture, tourism, transport, mining and oil and gas. Not less important is its role in climate change, especially since it is the least studied ocean, but central to climate patterns in the region and in the world. Brazil has an Atlantic coast that covers approximately seven thousand kilometers and requires adequate management, based on the best scientific knowledge available.

The Enlightenment Era mobilized the power of reason and opened the way for philosophy to bring light into darkness, knowledge into the imaginary, allowing the development of science in all its nuances, at a time when great explorers unraveled the Atlantic and broke new worlds and their richness. Today, a blue enlightenment comes to do justice to the Atlantic Ocean, uniting continents for science and breaking new knowledge still hidden from man.

Brazil has become an international exponent in oceanic and space science. This national effort is based on the greatness of our scientific pioneers, but it could not be done without international cooperation on issues of mutual interest and benefit.

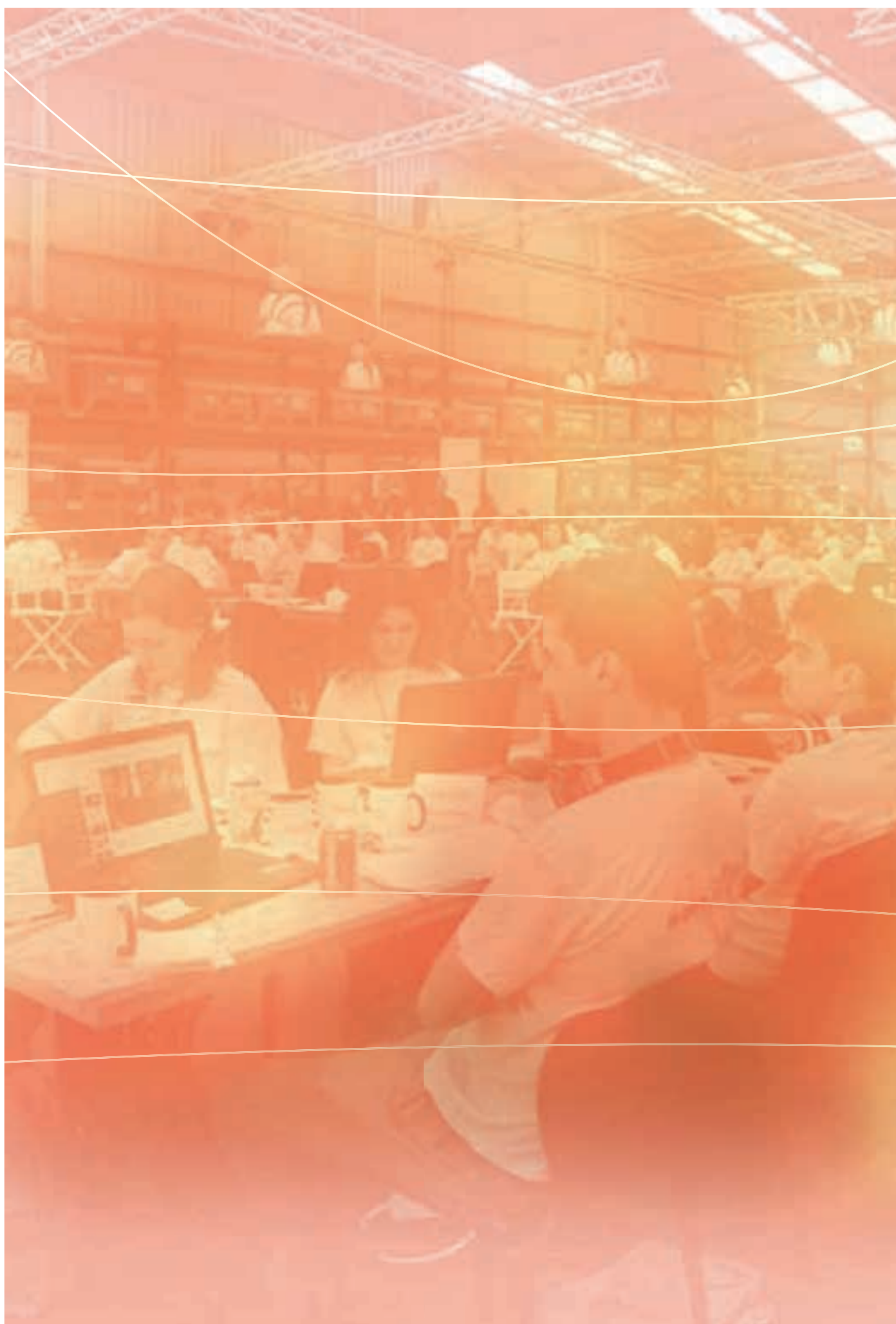
We have recently taken an important step in this construction. The European Union organized the conference A New Era of Blue Enlightenment to foster cooperation in the Atlantic as a whole. I had the honor of signing the Belem Statement with my colleagues Naledi Pandor of South Africa and Carlos Moedas, European Commissioner for Research, Science and Innovation. The Belem Statement should be a reference for new initiatives of international cooperation in scientific research in the Atlantic. I also had the pleasure to launch with my South African colleague the South-South Framework for Scientific and Technical Cooperation in the South and Tropical Atlantic and the Southern Oceans. Both instruments will be a sure path to the ideal goal of understanding the Xone Atlantic OceanX.

Strengthening the international cooperation in the Atlantic, the Ministry of Science, Technology, Innovation and Communications has been actively participating in the initiative launched and coordinated by my friend Manuel Heitor, Minister of Science, Technology and Higher Education of Portugal: the Atlantic International Research (AIR) Center, demonstrating the efforts that Atlantic countries are making towards integration.

In April, the Portuguese organized the first AIR Center summit in the Azores, where representatives from many countries negotiated the proposal for a new international center for research in oceans and space. Brazil is very proud to be co-leader of the initiative, which, among many actions, aims to promote a network of ocean observatories in the Atlantic Islands. We welcome all Atlantic friends to the next AIR Center summit in Florianópolis, which has unique historical relationships with the Azoreans.

With Portugal, the ocean that has never separated us will always be a topic of scientific-technological diplomacy. The Portuguese nation has given significant examples, which has been of great value for what is built in the Brazilian model. We should not miss the opportunities for international cooperation that the Atlantic offers us. The ocean bathes us with identity, progress and action. Space is our next frontier of knowledge. The synergy with other nations must be continually sought and improved. It is inevitable to see how much we are linked by the sea and how much the sea offers us in terms of strengthening our societies and economies, just as it is inevitable to think of the new tools that space research gives us and access to this new world.

Finally, we have advanced, together with the Academia, in an alliance in science and technology of the Atlantic through intense South-South and South-North scientific cooperation, from Antarctica to the Arctic, from the deep sea to space, an effort never before made and that will serve greatly for the Future We Want.



Nigeria's space facilities for the ocean studies

Ogbonnaya Onu

Minister of Science and Technology, Federal Republic of Nigeria

The Federal Republic of Nigeria, in her desire to explore space for peaceful and sustainable development, commenced preparations in the early nineteen eighties through infrastructural and human capacity development. These resulted in the establishment of the National Centre for Remote Sensing (NCRS), Jos, Plateau State, in 1995. By 1999, the National Space Research and Development Agency (NASRDA) was established to fast-track the development and application of space science and technology programmes for the socio-economic benefits of Nigeria, particularly in the areas of security, energy, environment, agriculture, communications, ocean studies among other fields.

2. The National Space Research and Development Agency operates six Centres of Excellence and seven Advanced Laboratories. These include:

- i. Centre for Satellite Technology Development (CSTD), Abuja, FCT;
- ii. National Centre for Remote Sensing (NCRS), Jos, Plateau State;
- iii. Centre for Space Science and Technology Education (CSSTE), Ile-Ife, Osun State;
- iv. Centre for Space Transport and Propulsion (CSTP), Epe, Lagos State;
- v. Centre for Geodesy and Geodynamics (CGG), Toro, Bauchi State;
- vi. Centre for Atmospheric Research (CAR), Ayingba, Kogi State;
- vii. Advanced Space Technology Applications Laboratory (ASTAL), Uyo, Akwa Ibom State;
- viii. Advanced Space Technology Applications Laboratory (ASTAL), Kano;
- ix. Advanced Space Technology Applications Laboratory (ASTAL), Ife;
- x. Advanced Space Technology Applications Laboratory (ASTAL), Abakaliki, Ebonyi State;
- xi. Unmanned Aerial Vehicle Laboratory, Uburu, Ebonyi State;
- xii. Aerospace Engines Laboratory, Oka-Akoka, Ondo State; and
- xiii. Aeronautics Engines Laboratory, Gusau, Zamfara State.

These centres work in constellation to deliver space services to the country and beyond. NARSDA also collaborates with other Research Centres and Universities in and outside of Nigeria to provide space related services.

3. The research activities of NARSDA in collaboration with the Nigerian Institute for Oceanography and Marine Research (NIOMR) show the ease of understanding the ocean through the application of space infrastructure. Some of these space infrastructures and their contributions to ocean studies include:

The National Oceanic Atmospheric Administration (NOAA) Data Receiving Programme:

The Ground Receiving Station (GRS) has been receiving data from the National Oceanic Atmospheric Administration (NOAA) satellite since March 2006, using its 0.8m Circular Antenna. Presently, the Ground Receiving Station manages these acquired satellite data for cloud analysis and environmental monitoring.

The Moderate Resolution Imaging Spectrometer (MODIS) Data Receiving Programme:

The real-time TERRA and AQUA data reception from Moderate Resolution Imaging Spectrometer (MODIS) satellite commenced in March 2010. MODIS has 7 ocean viewing bands at a resolution of 1 km. These bands are used to derive several ocean colour products such as chlorophyll concentration, sediment and dissolved organic matter concentrations daily. TERRA MODIS data is used to obtain daily chlorophyll charts of the West African regional waters. The daily charts are averaged over a month to produce a grid of regional chlorophyll data. The monthly averaged values are used to study the seasonal variations of chlorophyll concentration in the regional waters. On a daily basis, NARSDA tests for anomalous changes of chlorophyll concentration at each grid point against the corresponding monthly averaged concentration. Data obtained from this research are made available to relevant organizations / institutions for various purposes. Some of these institutions and purposes are:

NO.	ORGANIZATIONS	USAGE
1	Nigeria Air Force	Cloud high and moisture
2	Federal University of Technology Yola	Research
3	University of Jos	Research
4	National Water Research Institute, Kaduna	Flood outlook prediction
5	Forestry Research Institute of Nigeria	Biomass Index and Forestry Inventory
6	National Commission for Disease Control	Land Surface Temperature for Meningitis Prevalence

NARSDA has also carried out a project which was conducted in coastal areas using Landsat and NigeriaSat-1 in conjunction with NIOMR (Nigerian Institute of Oceanography and Marine Research). Below is the summary of the project:

- Space-Based Vulnerability Assessment of the Niger Delta to Abrupt Sea Level Rise

The objective of the study was to conduct a vulnerability assessment of the Nigerian coastal area to sea level rise with special attention on the Niger- Delta as well as other highly populated areas in the Nigerian coastal areas. The study covered the Niger Delta coastline focusing on Escravos (Ogborodo) beach, Forcados beach, Brass coast and Ibeno Eket (Strand) coast and involved:

- Analysis of tide gauge data for the determination of sea level rise trends along the coast.
- Study of the coastal line changes in the last twenty years.
- Assessment of the vulnerability of areas within the Niger Delta region to effects of sea level rise using the NARSDA satellite data.

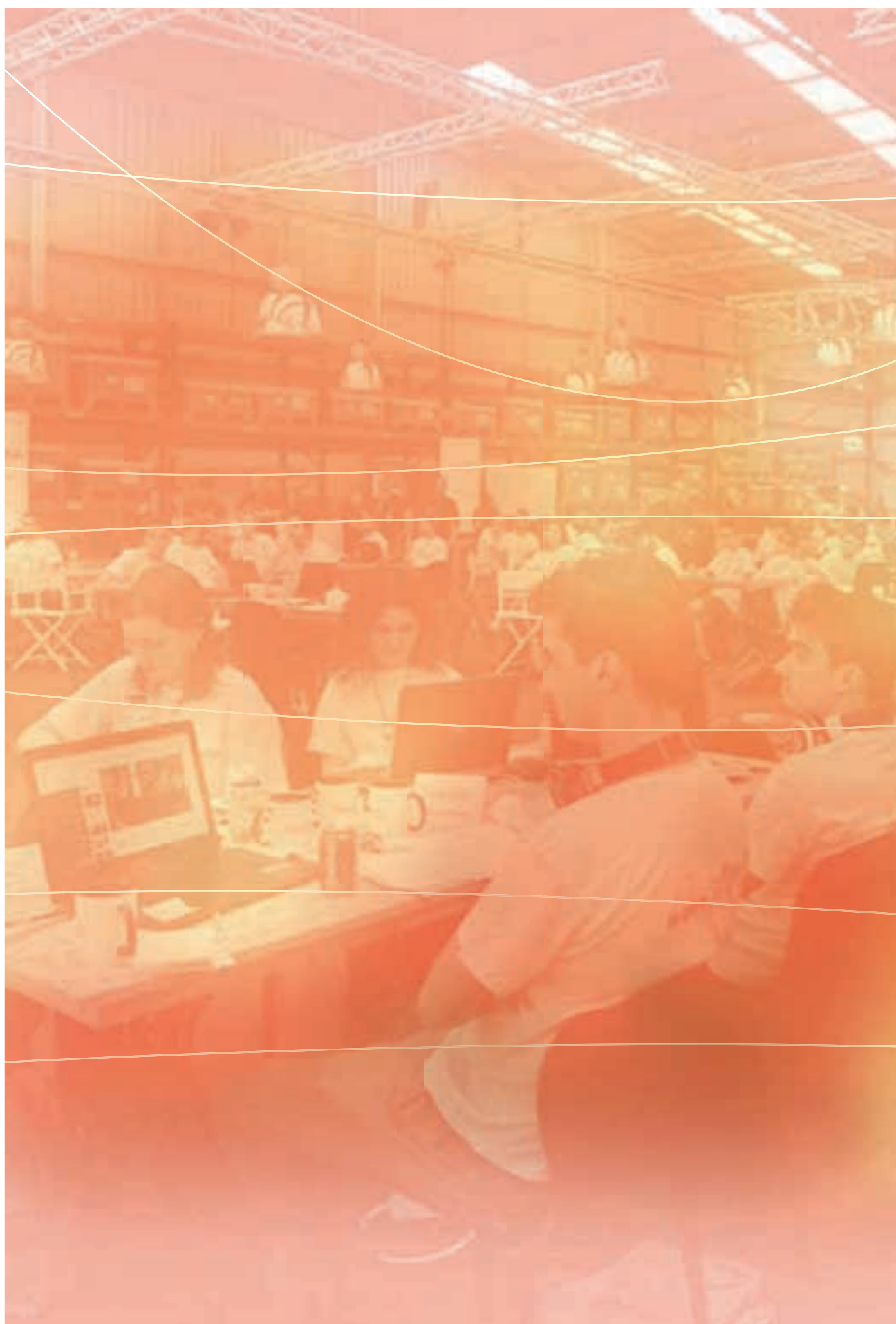
Data from NigeriaSat-1 and the methodology adopted in this study contributed to the success recorded by NASRDA.

Using the brightness inversion tool, the images from the satellites were preprocessed to enhance the interface between the sea water and beach sand area along the coast. Field work was conducted to identify the spectral signature for water as well as beach sand. Finally, using Digital Shoreline Analysis System, the shoreline rate-of-change statistics was calculated from multiple historic shoreline positions using linear regression, endpoint rate, average of rates and average of end points.

It is my hope these and other infrastructures of NASRDA will be of great benefit in the future study of the ocean under the Atlantic International Research Center (AIR Centre) which NASRDA will also host on behalf of Nigeria.

As Nigeria prepares to host the 1st Nigerian / Portuguese Scientists' Conference from 4th – 5th December, 2017, Nigeria's AIR Centre will be commissioned to signal Nigeria's preparedness to further expand the ocean studies using space facilities.

I congratulate His Excellency Prof. Manuel Heitor, Minister of Science, Technology and Higher Education of the Portuguese Republic, and hope this Compendium of one year of Science Diplomacy will further strengthen and show the centrality of science in sustainable development.



Atlantic Interactions: a commitment to Knowledge through global science and technology cooperation and science diplomacy

Vasco Cordeiro

President of the Regional Government of the Azores

First of all, I would like, as President of the Regional Government, and on behalf of the Regional Government, to welcome you all to the Azores. It was a pleasure to have you here and that pleasure is even greater considering the reasons that bring us together today.

So let me share with you some ideas about the way I see this meeting and what I consider to be its symbolism. And the first idea that comes to my mind is an idea of Redemption, because this is a true summit of Science. This is a true summit of commitment with Science, with Knowledge and with the ambition that the human being has to work and to improve his future.

And this idea of Redemption comes to my mind because, 14 years ago, there was another summit here in the Azores. That summit, the reasons behind it, its results and its outcome, in my opinion, placed the Azores in a negative perspective of History. It positioned the Azores and Terceira Island in a negative perspective of History.

I thus look at this meeting today as an opportunity to redeem the Azores name from that negative perspective and - given the genesis of this meeting, its motivations and the ambitious outcomes that it seeks for the Azores and Terceira – placing them in the good side of History. This is one of the first ideas I would like to share with you as President of the Regional Government.

Secondly, there are other three ideas about this meeting that I think are of the utmost importance.

The first of these ideas is ambition. The ambition that all people gathered here today have to develop a common approach, an approach based on Cooperation, on Knowledge and Science.

An ambition that flows from both sides of the Atlantic, but that also goes far beyond. The ambition that the people gathered around this table have to look for a better future, not only to increase Knowledge, not only to develop Science, but also to work for a better future.

This ambition is, in a certain way, anchored in the studies about Earth, Sea and Space that are the basis for this project, with which the Regional Government is profoundly committed.

Speech at the opening session of the High Level meeting on Atlantic Interactions, in Terceira, Azores, 21 April 2017

The second idea is exactly this one: commitment. Because I don't think we are here just to be in the most beautiful place in the world. That would even be a reasonable idea and purpose, but the idea of commitment is fundamental for the next phase of this project.

The Regional Government is committed with this idea, not only politically, but is also willing to commit resources, to make this idea work not only for the sake of the Azores, not only for the sake of Portugal, but for the sake of the end objectives contained in this idea.

And the third idea I would like to share with you is about responsibility. I think the moment we entered that door, all of us have a very strong responsibility. This meeting is not a point of arrival. It's a point of departure. It does not yet represent the end of the road nor the conclusion of the AIR Center project.

This is the point of departure. So, it is important that we all leave this meeting and this island knowing exactly what's next. And it is important to have in mind that if the idea of improving Knowledge is important, the idea of knowing more about Earth, Space and Sea is equally relevant.

The potential of this idea makes me also hope that we can go further, that the outcome of this idea may also play a fundamental role in creating jobs and wealth, not only in the Azores, but also in each one of your countries.

This is the big responsibility we all have. And I strongly believe that we can deliver on the promises that this idea has. We can work for the fulfilment of the goals that this project has. It does not depend of anyone else than the people and the institutions gathered around this table.

Thank you very muchC





SELECTED IDEAS AND CONTRIBUTIONS

ATLANTIC INTERACTIONS The 1st year of a process of scientific diplomacy

20



Atlantic Interactions: Knowledge, Climate Change, Space and Oceans

Miguel Belló Mora

New York, 10JUN2016

Space is today present in all aspect of human life. Space activities and technologies present a unique set of synergies across most sectors and human activities, but specifically, it is intrinsically intertwined with most scientific disciplines, specially those related to geodynamics of the land masses, the oceans and the atmosphere. Space is a clear vantage point for observing these large systems and their interaction and has been exploited in great measure because of that. Since the 60's, the history of space exploration has been shaped by the need to better know our planet, and the technology for accessing space evolving with it.

Today, space industry is undergoing a profound transformation. Technology trends related to electronics, materials and computational performances, building on top of a vast amount of legacy knowledge from the last 50 years, are opening the door to fast track, accessible, flexible space technologies fitting well with the requirements of a huge market for space data for science and commercial purposes alike. The same way, space in itself is turning into a market – the so called New Space – where private investors, entrepreneurs and visionaries, compete on scale, performances and cost, setting up agile supply chains to address a growing demand for space services backed up by new financing sources.

New Space paradigm is equally present in both the upstream and downstream dimension of the space sector. Upstream, where probably it roots its origins, it has been prolific in the development of fast satellite concepts and microlaunchers. Downstream, significant initiatives include data debris and NEO tracking, big data infrastructure to aggregate large space data sets, and large earth observation application targeting operational and scientific end users.

First actors in New Space emerged in US with new concepts of microsatellites and constellations for Earth Observation and Telecommunications (E.g. Skybox, Planetlabs, Backsky), but soon were followed in Europe with a number of commercial initiatives like SSTL (UK) or Elecnor Deimos (Spain) and some other academic projects. Small launchers development ramped up almost in parallel, by a number of actors across the globe, where Virgin Galactic (US), Rocketlabs (NZ) and Firefly (US.) are good examples. All together, investments into small satellite companies from 2009 to 2015 have reached almost 2,5 BUSD.

Recent projections (see Figure 1) based on announced and future plans of developers and programs indicate between 2 000 and 2 750 nano/microsatellites (class of 1 to 50Kg) will require a launch from 2014 to 2020. This translates into a launcher market estimation in the forthcoming years in the order of 100 to 300 launches per year, sought mostly by private sector customers.

A characteristic of New Space is its geographic distribution, no longer determined by institutional actors, but rather by a much more diversified set of conditions that bring regions into competition for this new vector of development, industrial resilience and knowledge accumulation.

Azores is well set within the middle of a center of gravity of the New Space between Europe and US. These islands, in the middle of the North Atlantic Ocean, had always presented an unquestionable geographical asset for both sides of the Atlantic. First as a major scale port on the transatlantic shipping lines and subsequently in flight routes crossing the Ocean, and finally to host important military presence since WW2, first from UK and then USA, which still happens in Lajes (Portuguese Air Force Base BA4). If the aircraft traffic no longer stops over in Azores, the location is still of paramount importance for the control of Atlantic routes. Portugal FIR, one of the largest in Atlantic, is

controlled from Oceanic Control Centre of NAV in Santa Maria. On the other hand, the military presence left a significant landmark in the region, with two airstrips of very large dimension in Santa Maria and Lajes and associated operational infrastructures.

Both NASA and ESA soon recognized the interest of Azores for space and had included the region on its operations, examples being the use of Lajes airstrip as the emergency landing location for Space Shuttle, or ESA defining Azores as sea landing location for PRIDE (former ARV Reentry vehicle) and more recently as host to ESA's tracking station and EU Galileo reference station.

Beyond geophysical conditions and current infrastructures, also the availability of low density airspace over low populated areas (Atlantic) and optimal regulatory framework in the region constitute a set of advantages for hosting space activities, in particular launchers, which are hardly found anywhere else in the world.

Likely, a space port in Azores constitutes a very long term, stable, and rich infrastructure where complex engineering processes take place. On this sense, it could generate interesting dynamics of knowledge generation, retention and cross-fertilization, giving new impetus to interactions with academia, research community, engineering and business along its life cycle. Something that would also mean an important opportunity to build on the relationship with USA, bridging the links with Europe over common interests in space exploration, technology development and economic returns.

The second dimension of New Space is space data and applications. Unprecedented amount of data originating from space assets is being produced daily, that feed into operational services and applications that span transversally into most sectors, from weather forecast to agriculture. Institutional programs such as Copernicus is probably the largest initiative for collecting and distributing public EO data from orbit. But the data stream from space is increasing much faster. The advances in space technology and the price erosion on satellites is attracting strong private investments into new mission concepts supported on large constellations of satellites, to provide both scientific and commercial services.

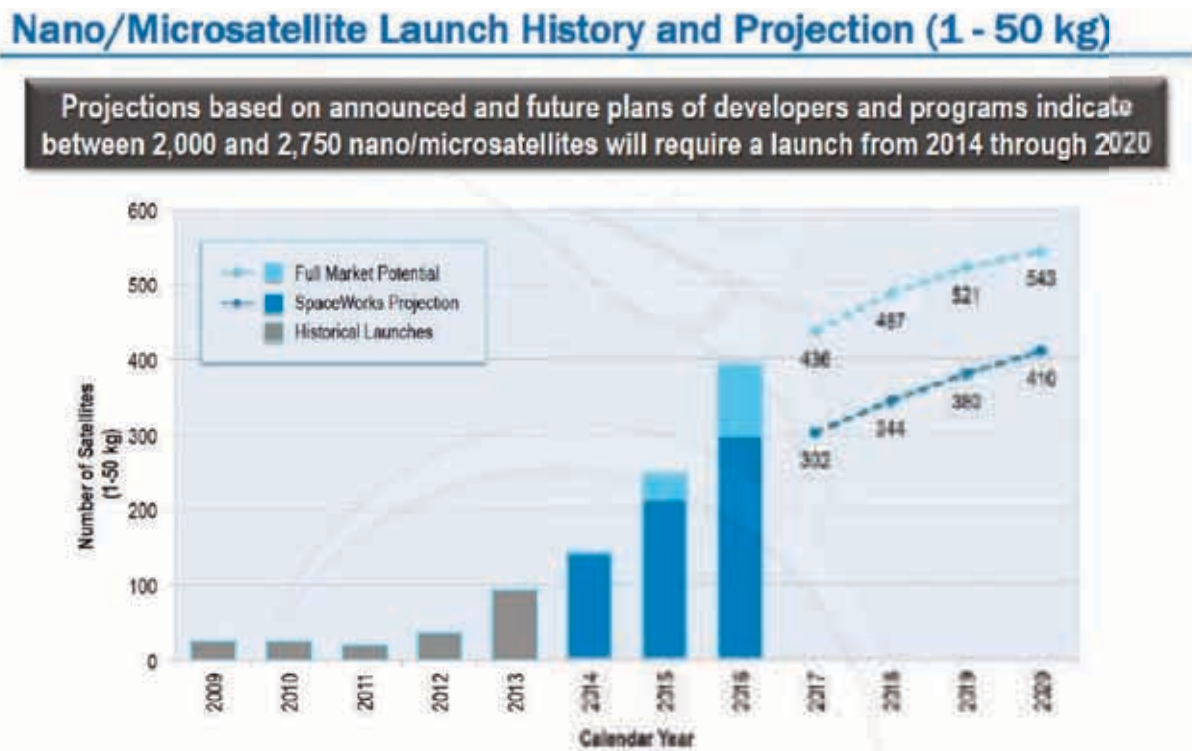
In itself, data collection, storage, organization and interoperability with incumbent sources and systems, is a technology challenge calling for new technology approaches, that perfectly fit into the objectives of AIR, namely new software paradigms based on distributed processing and storage.

But it is space based applications which are the key motivation for endorsing investments in space. Earth observation in particular is taking a prime role in multiple sectors. Examples including Climate Change, Oceanography Disaster Monitoring (Volcanic activities, Earthquakes and tsunamis, Flooding, Fires), Environmental Monitoring, Detection of suspicious vessels, Agriculture or Support to fisheries. Much of these, specially those related to oceans and geophysical dynamics find in Azores a particularly favourable context to be developed, fitting in great measure with most of the candidates activities in the AIR center, but having in Azores a particular field of application.

As a whole, Azores presents unique advantages for the space exploration industry and NewSpace revolution gives a unique opportunity for space in Azores. Both upstream, through small launchers and spaceports, but also downstream, where space data provides important synergies with all the other knowledge initiatives in AIR. In a Win-win relations, Azores presents optimum conditions for space, while space applications have in Azores a clear field of application.

Finally, the set up of space ventures in Azores opens new perspectives of diversification of Portuguese export base, in particular of its regional component onto the global markets. Engineering design and technology development activities are to take central roles, along with systems integration and other high value added activities. In a necessary long term perspective, it is reasonable to infer that investments in the space sector in Azores would positively concur to the attraction and retention of highly skilled jobs, the emergence of new value added supply chains, as well as fostering international scientific and technological collaboration, with great impact onto the socio-economic resilience of the region. In this regard, AIR would establish an ideal collaborative environment for promoting the competitiveness of Euro-American new space industry,

figure • 1





Enhancing Atlantic Marine Research Infrastructure at the Azores International Research Centre

Ned Dwyer

Executive-Director EurOcean

Introduction

The Atlantic Ocean is a shared space between a number of continents including Europe and North America. It has a huge influence on the climate and weather of both landmasses and it is a source of numerous living and non-living resources and contributes significantly to economic wellbeing. Nevertheless, there are still numerous outstanding scientific questions in relation to our knowledge of the ocean, both above and below its seabed and the changes it is undergoing due to anthropogenic pressures, including climate change. For example the dynamics of the Atlantic Meridional Overturning Circulation (AMOC) need to be better understood in order to predict how changes would affect climate and weather. Deep-sea research needs to be enhanced in order to understand the effects and impacts of the quickly growing underwater mining and extractive industries. Governance regimes need to be reviewed and enhanced both within and beyond EEZ limits. Such questions can only be adequately answered by combining efforts across the Atlantic and supporting research and innovation with world class infrastructure such as that proposed for the Azores International Research (AIR) Centre

Europe's Blue Growth Strategy and International Cooperation

Since 2007 Europe has been developing an Integrated Maritime Policy¹, which seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy areas. An important aspect of this strategy is Blue Growth which aims to support sustainable growth in the marine and maritime sectors as a whole. It comprises three main components, namely:

1. Develop sectors that have a high potential for sustainable jobs and growth, namely aquaculture, tourism, marine biotechnology, ocean energy and seabed mining.
2. Provide essential components to provide knowledge, legal certainty and security in the blue economy including more marine knowledge, marine spatial planning and integrated maritime surveillance
3. Develop Sea basin strategies to ensure tailor-made measures and to foster cooperation between countries. This includes the Atlantic Ocean.

Supporting this strategy, especially in terms of enhancing marine research cooperation between Europe and North America is the Galway Statement on establishing a Transatlantic Ocean Research Alliance². This statement was signed in 2013 by the European Union, United States and Canada and promotes specific cooperation in relation to improving coordination of ocean observation infrastructures and seabed and benthic habitat mapping, data sharing and interoperability between systems.

¹ http://ec.europa.eu/maritimeaffairs/policy/index_en.htm

² <http://ec.europa.eu/research/iscp/index.cfm?lg=en&pg=transatlantic-alliance>

The EuroGOOS (European Global Ocean Observing System) has over 40 members from 19 European countries and provides operational oceanographic services and carries out marine research. In a policy brief³, launched in May 2016 it identifies a number of priorities for European Oceanography including improved ocean modelling and forecasting and the development of a European Ocean Observing System (EOOS) to provide a focal point and a framework for European research and operational oceanography. In terms of Transatlantic cooperation, establishment of an EOOS would be a major contribution to supporting the implementation of an ocean research alliance.

Europe's Marine Research Infrastructure

Europe has an extensive marine research infrastructure. This includes a fleet of research vessels and their underwater instruments, coastal and open ocean observing systems, specialised laboratories for biological and ecosystem studies, research and test facilities for ocean engineering, ocean observing satellites and marine data repositories. Over 900 of these infrastructures are listed and described in EurOcean's Research Infrastructures Database⁴.

Coordinating and streamlining development, access and usage of such infrastructure is one of the goals of the European Strategy Forum on Research Infrastructures (ESFRI)⁵. Since its establishment in 2002, ESFRI has supported scientific integration across Europe by assisting infrastructural partnership projects along the road towards becoming legal entities constituted as European Research Infrastructure Consortia (ERICs). In the marine domain Euro-ARGO is one such ERIC. This is Europe's contribution to Argo - a global array of autonomous instruments deployed over the world ocean and reporting near-real time subsurface ocean properties to a wide range of users via satellite. Closely related is the Integrated Carbon Observation System (ICOS) ERIC, with a focus on improving greenhouse gas monitoring and improving understanding of carbon sources and sinks.

ESFRI landmarks are initiatives which are on the roadmap towards becoming an ERIC. The European Multidisciplinary Seafloor and water-column Observatory (EMSO) is one such landmark initiative. It consists of fifteen nodes or observation sites across all European sea basins, and includes a site located near to the Azores islands. This site consists of two non-cabled stations, one equipped with an ocean bottom seismometer and pressure gauges (figure 1), the other with a range of bio-chemical sensors. EMSO is fostering the development of innovative services by making data available to industry including SMEs and is well positioned to collaborate in transatlantic initiatives.



Figure 1: The SeaMON West moored station in the EMSO Azores node is dedicated to geophysical observations

³ <http://eurogoos.eu/2016/05/18/3512/>

⁴ <http://rid.eurocean.org/>

⁵ http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri

Marine relevant projects which have just joined the ESFRI process include the European Marine Biology Resources Centre (EMBRC) and the Svalbard Integrated Arctic Observing System (SIOS). The former has the goal to support both fundamental and applied research based on marine bio-resources and marine ecosystems, thereby facilitating the development of blue biotechnologies, whilst the latter is aimed at improving our understanding of environmental and climate-related challenges in the Arctic. There are four Portuguese partner organisations in the EMBRC project including the Institute of Marine Research based in the Azores.

Complementing these in-situ infrastructural components is the European SENTINEL series of satellite observation platforms, which host a range of sensors which can be used to observe different aspects of the ocean. These hardware aspects are supported by the Copernicus services which are derived from and based on the data collected by these satellite platforms and others. One of the key aspects of Copernicus is its marine monitoring service.

The ESFRI Roadmap 2016 notes that deep sea regions are still under-sampled, and that additional nodes are needed and technological developments are required. It also supports the establishment of an EOOS to fill the real need for cross-disciplinary research and multi-stakeholder engagement.

Reveraging the Marine Research Infrastructure

Competitive European scientific research funding, much of which comes through the European Commission's Research Framework programme (e.g. FP7, H2020), supports projects which take advantage of the above marine infrastructure. For example the Fixed point Open Ocean Observatory network (FixO3) project aims to improve researcher access to such observatories – including those in EMSO- and provide free and open data services and products. A complementary project is JERICO-NEI T which is strengthening and enlarging Europe's coastal observation capacity. Similarly EUROFLEETS is supporting coordinated access to European marine research vessels and equipment. Other such infrastructural support projects include MaRINET, supporting the development of ocean energy and SeaDataNet, a pan-European infrastructure for ocean and marine data management.

Enhancing international collaboration is one of the key aims of the latest H2020 research framework programme. Through this Europe supports international cooperation on marine research and access to relevant infrastructure. For example the COOPe project aims to strengthen the links and coordination of the ESFRI research infrastructures related to Marine Science (EMSO), Arctic and Atmospheric Research (EISCAT), Carbon Observation (ICOS) and Biodiversity (LifeWatch) with international counterparts including some in the United States (e.g. Ocean Observatories Initiative (OOI)).

The H2020 funded Atlantic Ocean Research Alliance coordination and support action⁶ aims to support practical implementation of the Galway Declaration by providing technical and logistical support in fostering cooperation between the European Union, the United States and Canada. Among its research themes are improving access to marine research infrastructures, ocean observations and seabed and benthic habitat mapping.

All these initiatives demonstrate that Europe is advancing in coordinating its marine research infrastructure and has also put in place mechanisms to improve access, use and derive added value from such infrastructure. Nevertheless, there is still much to be done to fill gaps in the physical infrastructure, build additional capacity and skills and enhance international cooperation for its use.

Filling the Gap – The Azores International Research Centre

In a recent publication (Schiermeier, 2013)⁷ it is urged that the North Atlantic Ocean be monitored as part of an Abrupt Change Early Warning System in relation to the AMOC. Although a monitoring array is in place at approximately 23° North and another is planned at approximately 55° North, (Figure 2) it would be interesting to investigate the potential for enhancing monitoring around 40° North, where part of the AMOC divides. An infrastructure located in the Azores, would be well positioned to lead on and service such a monitoring programme. Equipment could be deployed and serviced, ship travel time, to inspect and repair fixed observing stations, could be minimised and data could be received and processed at such a centre.

⁶ <http://www.atlanticresource.org/aora/>

⁷ Schiermeier, Q., (2013), Oceans under Surveillance, Nature, 497, 167-168

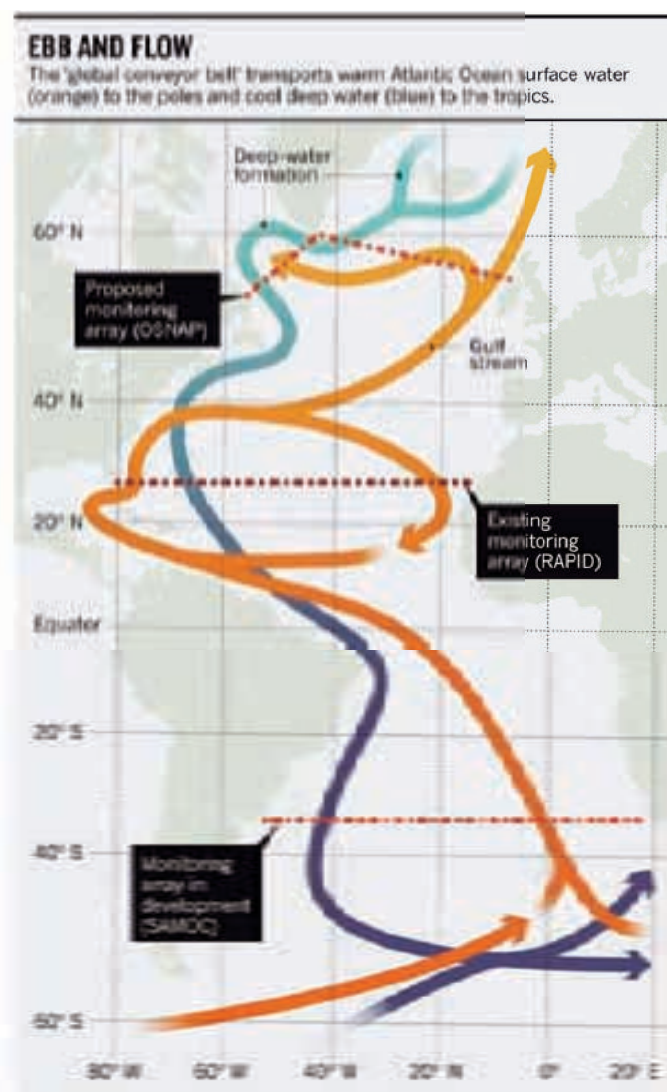


Figure 2: Existing and proposed instrumentation arrays for monitoring the AMOC (Schiermeier, 2013)

Although there is an un-cabled monitoring node located near the Azores as part of the EMSO network, there is scope for significantly enhancing seabed and water column monitoring by developing a fully cabled set of sensors. The AIR Centre would be ideally positioned to lead on such a development and also to work with international partners to deepen links and collaboration.

The position of the Azores in the open ocean surrounded by waters which in places plummet to more than 4000m makes it the ideal location from which to conduct deep sea research. The European Marine Board's paper on deep sea research⁸ calls for an enhancement of relevant infrastructure in order to answer a variety of questions on the deep ocean ranging from understanding patterns of deep sea biodiversity to monitoring how human activities impact on the deep ocean. Infrastructural requirements include the development of vehicles and sensors that can operate below 200m, improved underwater position systems and communications and in-situ experiments to investigate unknown biodiversity and functions. The AIR Centre would make an ideal and unique contribution to leading on and supporting such developments and become the focus for deep-sea research in Europe and beyond.

The potential to receive, process and analyse data from complementary satellite, surface and sub-surface ocean observatories at a mid-Atlantic location would be a unique contribution to improving our knowledge and understanding of our shared ocean – the Atlantic.

⁸ <http://www.marineboard.eu/deep-sea-research>

Conclusion

Europe has made great strides in developing and co-ordinating its marine research infrastructure over the last decade in order to support its Integrated Maritime Policy. Moreover it has supported a range of initiatives and projects to take advantage of the data and information being provided by such an infrastructure. It recognises the need for international collaboration and in regard to the Atlantic has taken practical steps to enhance the working relationship with Canada and the United States. Nevertheless, there are still significant gaps in our understanding of the Atlantic Ocean, both above and below its seabed. The establishment of the AIR Centre in the Azores would be a key contribution to further enhancing ocean research infrastructure in a key area of the Atlantic, and to fostering international cooperation between Europe and North America.

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ARM Climate Research Facility – Eastern North Atlantic (ENA) site on Graciosa Island, the Azores

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US Department of Energy
June 1, 2016

The Atmospheric Radiation Measurement (ARM) Climate Research Facility (www.arm.gov) is a scientific user facility operated by the US Department of Energy's Office of Biological and Environmental Research. ARM provides the climate research community with strategically located atmospheric observatories designed to improve the understanding and representation in earth system models of aerosol and cloud processes, their interactions, and their impact on the Earth's energy balance. ARM's goal is to provide a detailed and accurate description of the Earth's atmosphere in diverse climate regimes to resolve the uncertainties in climate and earth system models in order to inform the development of sustainable solutions for the Nation's energy and environmental challenges.

ARM operates ground-based observational sites at three fixed locations representing a range of climate conditions – the U.S. Southern Great Plains, the North Slope of Alaska, and the Azores. ARM also operates three mobile facilities, which provide flexible instrument platforms for conducting field experiments lasting from 6 to 24 months in diverse climate regimes. Each fixed site and mobile facility contains a suite of in situ and remote sensing instruments including shortwave, longwave, and microwave radiometers; ceilometers and lidars; cloud radars; surface meteorological instruments; and aerosol and trace gas systems. The ARM Aerial Facility uses aerial platforms to obtain key in situ and remote sensing measurements to complement the ground-based observations and contribute to the fundamental understanding of clouds, aerosols, and radiation.

In collaboration with the University of the Azores and the Azorean Regional Government, ARM has operated an atmospheric research site on Graciosa Island in the Azores, Portugal since September, 2013. This site, which is known as the Eastern North Atlantic (ENA) site, follows a successful 18-month deployment of the ARM Mobile Facility that took place on Graciosa Island during 2009-2010 for the Clouds, Aerosol, and Precipitation in the Marine Boundary Layer (CAP-MBL) field campaign. The Azores are located in the northeast Atlantic Ocean, a region characterized by persistent but diverse subtropical marine boundary layer clouds. Response of these low clouds to changes in atmospheric greenhouse gases and aerosols is a major source of uncertainty in global climate models. Interactions between aerosols and clouds can impact cloud dynamics, turbulence, entrainment, formation of precipitation, and cloud brightness (or albedo). Boundary layer aerosol in the ENA region is influenced by a variety of sources, including periodic downwind transport of anthropogenic aerosol from the North American continent. Data from the ARM mobile facility deployment at Graciosa resulted in the first climatology of the detailed structure and variability of cloud and precipitation properties at this remote subtropical marine site, and confirmed that the Azores is an important region for studying interactions of aerosols and clouds in the marine boundary layer. The operation of the ARM fixed site at ENA will provide the long-term continuous measurements needed to gather enough data to fully characterize the atmospheric properties and robustly evaluate models under the full range of meteorological conditions observed.



In 2017-2018, ARM hopes to deploy the ARM Aerial Facility Gulfstream-1 (G-1) research aircraft to the ENA site for two intensive observational periods during the summer and winter to measure key aerosol and cloud properties under a variety of meteorological and cloud conditions and different aerosol

sources. During the summer, the Azores experience overcast stratocumulus that transition to broken trade cumulus, while during the winter they experience maritime frontal clouds. The aircraft measurements will provide comprehensive in situ characterizations of boundary layer and lower troposphere structure, and associated vertical distributions and horizontal variabilities of low clouds and aerosols over the Azores to complement the ground-based ARM measurements.

As a DOE scientific user facility, all ARM data is freely available to the scientific research community. Through a user proposal process, ARM can provide logistical support for collaborations at the ENA site including activities such as guest instrument deployments, special scanning of an ARM radar or lidar instrument, enhanced radiosonde launches, collection of aerosol or precipitation samples, or requests for special data products.



Comprehensive Cyberinfrastructure For The AIR Center

J. M. Sanchez

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Modern cyber-infrastructure is focused on the development of new interfaces to support data analysis, collaboration and sharing, reproducibility as well as easy access to simulation. The research community engaged in climate change research and large scale monitoring, modeling and simulation of earth phenomena is keenly aware of the need for a robust cyber-infrastructure in order to accelerate the pace of scientific discovery. In particular, the proliferation of datasets, modeling tools and the convergence of diverse disciplinary expertise calls for an integrated and efficient approach to data curating, analysis and visualization. The ultimate goal and objective of a robust cyber-infrastructure in support of the mission of the Azores International Research Center is to provide enabling tools to researchers in order to maximize their ability to navigate across data sets, computational models and a variety of disciplines. Ideally, the tools should have components accessible, and of demonstrated value, to policy makers and to non-experts in the general public.

We propose the development and implementation of a cyber-infrastructure that is deemed essential to the success of AIR: a Research Cloud dedicated to the AIR Center, and a portal, iAtlantic, which will be designed and deployed to integrate a comprehensive set tools and technologies linking the science and engineering relevant to the Azores and the North Atlantic. The vision for iAtlantic is that it will become a widely used and indispensable site of reference for the international research community, policy makers and the public in general.

The Texas Advanced Computer Center (TACC) at UT Austin provides the software, hardware, services and team for end-to-end computational science for tens of thousands of scientists and engineers in the U.S.A and beyond. At present, the Center counts with 160 staff members, 70 of whom hold PhD and other advanced degrees ranging from computer science, biology, engineering, geoscience and astrophysics to the humanities and communication sciences. Thus, the Center counts with the physical and intellectual resources to support a truly trans-disciplinary and convergent approach needed to achieve AIR's vision.

The advanced computing ecosystem at UT Austin (see figure below), has allowed TACC to play a key role in the development of a first of its kind Research Cloud, Jetstream, aimed at providing researchers with computational and data analysis capabilities on demand. Likewise, TACC is a key partner in the development cyber-infrastructures for the biological sciences such as the iPlant Collaborative and other open-access online community resources for biological research and in support of grand challenges in the life sciences.



Atlantic Interactions: Knowledge, Climate Change, Space and Oceans

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June 10, 2016

During the past 10 years I have had a distinct privilege to actively learn about the amazing Azores Islands, Portugal through my participation in the CMU-Portugal program. I also had an opportunity during my sabbatical stay in 2010 at MITEI to be hosted by Professor Ernest Moniz. This made it possible to collaborate with our colleagues at MIT, IST, Porto and Univ deAzores on collecting data about the electric energy systems in Sao Miguel and Flores islands.

We began by tackling a common-sense question regarding technological innovation needed to replace fossil fuel-based power plants in Sao Miguel and Flores by the abundant clean resources, wind power in particular. We managed to create now publicly available basic repository about these electric power systems, including historical load data and electric energy resource pattern utilization. This information became essential for a multi-year research carried out by about a dozen graduate students at CMU on different aspects of electricity service provision for these islands. We used the information about these islands as a realistic starting point for studying what is and what might be possible on the road to clean, reliable and efficient electricity services. As a result, we published a book entitled KIT-Enabled Engineering of Sustainable Electricity Services: The Case of Low-Cost Green Azores Islands', published by Springer in 2013. The book became one of the 25d most popular books at Springer. We used the book at CMU for teaching smart grids on the same real world system. I was told that several other universities use it as well.

I believe that this textbook is the first of its kind representing end-to-end solutions to transforming today's polluting electric power systems to the power systems of the future in which demand response, distributed electric energy resources are enabled by embedded physics-based models and software for monitoring and data-driven decision making. Physics-based models were used to design cyber for predicting demand, for scheduling resources and for fast automation of storage (like flywheels) to control instabilities created by fast fluctuations in outputs from renewables.

¹ uility o lea-e om aLi o La oato appoiome. e idea pced e a e o LL.

As a result, we conceived the vision of Dynamic Monitoring and Decision Systems (DyMoNDS) framework for operating electric power grids with lots of renewable resources and active demand participation was introduced. At present we are working proactively to scaling up this framework for operating large-scale continental power systems with high penetration of renewable resources. I just testified at the invitation of the US Federal Energy Regulatory Commission (FERC) on 2016 State of Reliability. I pointed out in my testimony which is available on FERC website that there exist major potential opportunities and challenges when attempting more flexible electricity services by integrating lots of renewables. Notably, the key vision has remained the DyMoNDS framework now for large-scale continental power grids, like the US electric power system. My testimony was received in a very positive way and I was asked by the FERC Commissioners to continue working toward exploring possible solutions to common protocols and standards needed to integrate renewables in a reliable and efficient way. Also, we have designed so-called Smart Grid in a Room Simulator (SGRS) at CMU in collaboration with US NIST to based on DyMoNDS framework. These concepts are very complex and having worked on them on a much smaller confined Azores Islands electric power grids first has been extremely helpful in a long run. I am extremely grateful for having had the opportunity to participate in this amazing collaboration between Portugal, CMU and MIT. Without having had the opportunity to think about Azores Islands challenges in a very tangible way probably DyMoNDS framework would not be where it is now. Throughout this journey, Prof. Jose' Moura has been an amazing catalyst of this multilateral collaborations.

While we consider the collaboration a success in many ways, it has remained an open wish to carry what we learned to the next step in the Azores Islands. We very much have been hoping to get investors to make Azores Islands the leading real-life experiment for smart grids in which cyber enables physical performance at well understood value to end users and to the society. This is where we are currently, no vendors are proactively innovating. Unfortunately, the Azores Islands are still being served with lots of expensive polluting power. There also exists a very real danger of lots of operating problems as new wind power plants are being added, for example.

It is with all of the previous experience in mind that I enthusiastically support the AIR Initiative. While the goals as I understand them are much broader and are targeted toward establishing an ambitious observatory, I would like to pursue work on modeling Terceira Island electric power grid, its existing and future users and resources. Much as in the past, we would like to explore the technical question regarding integration of clean resources and adaptive load management key to reducing reliance on currently used fossil fuel-generated electric power. We would like to explore technical feasibility of replacing fossil fuel plants with wind and solar power. We would like to study tradeoff between cost and complexity of DyMoNDS-like software needed to manage newly considered variable energy resources in coordination with active customer participation, on one hand, with the long-term economic and environmental benefits. Having done this once before for Sao Miguel and Flores, we anticipate that we could model, simulate, design control, sensing and communications required much faster. The new effort will be needed to understand the load composition and ability of major large loads such as the Air Force Base consumption for their ability to respond to the availability of renewable energy.

There may be previously unexplored synergies between R&D for smart electricity service, and massive data collection by the observatory. Data processing could provide much more granular accurate predictions of weather conditions, in particular. The more predictable power consumption and generation patterns, the more efficient and cleaner electricity service is possible. We are intrigued by the ability for the observatory as the electricity consumer to participate in supply-demand balancing on the island, by, say well-designed thermal control. And, of course, we would like to work closely with the Air Force base personnel to explore possible flexible solutions to energy consumption.

In short, our participation could help set the ground for a living laboratory micro-grid and enable us to explore many novel automation and cyber solutions and their role in enabling its operation by integrating very high percent renewable resources. We now based on our research to date that there exist many novel highly dynamical challenges to operating microgrids with fast power electronically controlled automation. It may become possible

to demonstrate how DYMoNDS-based protocols and standards for microgrids could enable user friendly integration and evolution of safe, reliable and clean microgrids. In this sense, AIR effort would become a testbed for integration of DERs in larger continental power systems. At present there are no such test beds. Hawaii is a hybrid mix of old and new. Terceira would be explored as almost a green field design problem.

Last, but not least, it is our hope to develop and demonstrate through simulations tangible performance metrics which measure the effect of smart technologies on climate change. This has never been done and it remains an illusive concept unless it is supported by real data.



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The Contribution to Atlantic Interactions

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The Ocean is probably the least known Earth domain. This conflicts with the sustainable exploitation and resilience of marine ecosystems. The Ocean interacts with the mainland over vast coastal areas, which undergoes severe erosion and anthropogenic pressures raising serious socioeconomic problems. The exploration of marine resources (including renewable energy) and integrated management of the ocean must be based on deep scientific knowledge and technical capacity. It is necessary to invest in research and capacity building able to contribute to increase the added value of blue economy along with its sustainable development. CIMA is quite aware of these challenges.

1. CIMA MISSION

CIMA is a multidisciplinary center created in 1998, funded by the Portuguese Science Foundation (FCT), and is one of the main Research Units of the University of the Algarve, that explores the interconnectivity between environment, processes and human population using scientific methods coupled with state-of-the-art modelling techniques. Apart from research, CIMA places a strong emphasis on training and education, as well as providing consultation services, digital applications and transfer of scientific information to the scientific community and to the public domain. Therefore, CIMA mission is to develop activities in the following areas:

- research
- advanced training
- knowledge transfer

Within the new emerging technologies, CIMA has experts on tidal and wave energy, ecotoxicological impact of deep-sea mining, maritime surveillance and has some expertise in biotechnology. CIMA has a long expertise in marine pollution and on coastal zone management and is organized into the following scientific areas

- Ocean observation
- Climate variability
- Transitional waters
- Coastal processes and risks
- Environmental quality and remediation
- Energy and resources

2. OCEAN OBSERVATION

Observing Earth from space is essential for monitoring the Ocean and different initiatives have been taken with this aim at international level. The Copernicus program of EC represents a main example where data collected by orbiting sensors are acquired and processed to complement information derived from in situ measurements. Acknowledging the success of the proof-of-concept ESA MERIS mission, Copernicus is now reaching full operational capabilities for ocean color remote sensing thanks to the OLCI sensor on board of the Sentinel-3A space platform. The satellite was launched in February 2016, and the mission is now undergoing the commission phase prescribed by ESA and EUMETSAT. Data delivery to users will start soon. It is also highlighted that by 2020, Sentinel-3A will be complemented by additional 3 twin satellites hosting sensors to equivalent OLCI for an increased ocean color observation performance. Aware of the importance and challenge opened by this unprecedented information source to monitor the marine environment, CIMA has established a solid expertise in operational marine optics, algorithm development and radiative transfer modeling. Competences of specific relevance for the Atlantic Observatory are highlighted below.

CIMA is committed to the assessment of OLCI data products as member of the ESA Sentinel-3 validation team. Match-up analysis of space-born primary radiometric data is performed acquiring radiometric data in the field using the TriOS/RAMSES above-water system. Besides, the analysis of water samples collected simultaneously with the radiometric field measurements is undertaken for the match-up assessment of higher-level products such as the concentration of the Chlorophyll-B or the Total Suspended Matter. The CIMA expertise in statistical data analysis also permits the exploitation of field measurements to develop ocean color inversion algorithms based on neural nets, in addition to standard polynomial regression schemes. Different products maps implemented and tested by CIMA members have demonstrated the need to adopt regional solutions for improving the quality of standard results in coastal areas, as well as in oceanographic region with increased optical complexity. The processing of remote sensing images in selected regions of interest has been undertaken accounting for the validity range of the regional products. CIMA is also an European top center for what concerns the execution of radiative transfer modeling in the marine environment. Monte Carlo simulations have been executed on computer clusters (e.g., the Navigator supercomputer of the University of Coimbra) relying on high-performance processing techniques to account for the effects of light polarization and a fine representation of the sea surface statistics. Results have allowed for devising refinements of measurement protocols of both in- and above-water radiometric systems, as well as to address consulting services to other main research institution such as the Joint Research Center of EC.

3. CLIMATE VARIABILITY

Portugal and the Algarve in particular can be seen as a climate hub for climate change studies. Indeed, it is located within the southern pole of one of the major pattern of atmospheric circulation (i.e. North Atlantic Oscillation) and therefore driver of climate variability within the North Atlantic basin at present. The South of Portugal is also a key site in terms of primary production as a consequence of the oceanic southern Portuguese upwelling or the Gulf of Cadiz Circulation input to the Atlantic Ocean.

Accordingly, CIMA has devoted a significant effort to i) know from the past; characterize past climate variability, namely focusing on reconstructing past tempestology through the study of sand bodies and sediment lagoon archives along the coast, stalagmites from caves close to the shore, or sediments from the continental shelf; ii) learn from present; survey present conditions and changes mostly in the marine and continental hydrosphere to obtain present-day analogs, and iii) safeguard the future; model coastal morphology adaptation based on sea-level change scenarios and assess expected impacts over human economy.

4. COASTAL PROCESSES AND RISKS

Coastal areas are fragile and continuously evolving boundaries often facing intense human occupation. Recent and historic high-impact events have demonstrated the coastal erosion and flood risks faced by exposed coastal areas in both Europe (North Sea storm surge in 1953,ynthia in 2010) and USA (Katrina in 2005, Superstorm Sandy in 2012). Those large flooding events pose a significant risk and can devastate and immobilise large cities and countries. The projected economic development and population growth at coastal areas in association with

climate change, with rising sea levels and changes on storminess, will further increase the possibility of consequences associated to extreme events in the future. This projected increase in risk along coasts requires a re-evaluation of coastal disaster risk reduction strategies and the development of the best possible concepts on prevention, mitigation and preparedness, including the development and application of early warning systems. The development of Building with Nature methods, or the Living Shores approach, is paramount for the preservation of the natural values, for a sustainable exploitation of their ecosystem services and to increase the natural resilience of the coastal environments. The continuous monitoring of coastal areas and the re-evaluation of coastal management approaches will provide information to improve coastal management, in a cost-efficient mode, at the same time that natural values are preserved.

CIMA has been for a long-time involved at coastal research and coastal management projects and programmes, including the co-leadership of the last two major European funded projects on the development of early warning systems and disaster risk reduction (MICORE FP6 Program; RISCKIT FP7 Program). CIMA has a well-established national and European leading team on coastal dynamics and management, with expertise on monitoring, modelling, risk assessment, development and analysis of management measures, among others. The main achievements of the CIMA research group on coastal dynamics and management include: the development of methods to define set-back lines both on sandy and rocky coasts; the characterization of hazards associated to storms, storm surge and sea level rise; the evaluation of the impact of overwashes; the understanding of the processes involved on barrier islands and inlets evolution; the characterisation of rip currents on embayed beaches; the definition of coastal evolution trends after coastal management actions; and the determination of the dynamic of estuaries and their response to basin regulation by man.

1. ENVIRONMENTAL RISK AND REMEDIATION

Given the worldwide resource limitation of some land-based metals and the recent deep-sea technological developments, interest in seabed metal and rare earths exploitation from polymetallic nodules and crusts, and massive sulfide deposits increased. Deep-sea mining activities are likely to release contaminants to the water column. Excavation and crushing of minerals at the seabed, plus their transport to the processing vessel and the discharge water that will likely be disposed near the seabed, will originate plumes of unknown spatial and temporal magnitude. These plumes will potentially transport contaminants that can be bioavailable and accumulated by deep-sea and pelagic fauna and affect marine biodiversity. Therefore, environmental issues related with deep-sea exploitation attracted the attention of G7 that in the German summit in 2015 identified as a priority issue for sustainable deep-sea mining the need to develop an environmental impact assessment and deepen scientific research in this area. CIMA has more than 15 years of experience as an ecotoxicological reference laboratory to assess the ecotoxicological effects of deep-sea hydrothermal vents in deep-sea invertebrates. Furthermore, CIMA is currently involved in the MIDAS EU project, which involves partners from several international institutions (including the International Seabed Authority - ISA) and also the University of the Azores, with the aim to help establish guidelines for the sustainable management of exploitation activities of deep-seabed resources. These guidelines will be essential to the implementation of regulations and legislation by the United Nations (through ISA), that will be followed by all signing nations of the UN Convention on the Law of the Sea. CIMA has already contributed with a new method (T6U and is developing others) for metals toxicity tests specific to deep-sea organisms that take into account the special environmental conditions of the deep sea (high pressure and low temperature) and will be essential to establish thresholds and limits of contaminants in deep-water fauna. It has further demonstrated that the generation of an artificial plume on a mine tailings deposit in a shallow-water region, negatively affects fauna, and proposed a model for ecotoxicological risk assessment (Mestre et al. in prep). CIMA, also through its participation in EU Action COST Action TD1407 (Network on technology-critical elements - from environmental processes to human health threats), has recently begun to assess the impact of some rare earth elements in marine organisms, for which ecotoxicological knowledge is lacking.

The oceans have been for centuries the sink of several contaminants from land-based sources and recently marine litter has become a threat to the health of the oceans and consequently to biodiversity. The south coast of Portugal is threatened by not only contaminants from land-based sources but also from the impact coming from the Mediterranean Sea where 80% of the sewage is untreated. CIMA has for some time monitored the levels and effects of metals and persistent organic pollutants in marine invertebrates. Plastics are a new threat to the health

of the oceans due to its extremely slow degradation in the ocean. It is estimated that plastics in the oceans may be over 5 trillion weighing around 250 000 tons and in the seabed can reach 10000 items per hectare. CIMA has a long experience in assessing the effects of traditional (metals and persistent organic compounds) and emerging contaminants (nanoparticles, Personal Care Products and pharmaceutical compounds) in marine organisms and started two years ago to develop the research on the effects of micro plastics in marine species and is currently under a JPI Oceans project EPHEMARE to assess the impact of micro plastics and as a vehicle of transport of other contaminants to marine organisms. Preliminary results concluded that the presence of polystyrene affects the clam *Scrobicularia plana* (Ribeiro et al. submitted). Oil Pollution is another threat to the oceans. The U.S. National Academy of Sciences (US National Research Council (2009)) estimates that every year over 600,000 tonnes of oil are spilled into the marine environment due to human activities. Operational discharges associated with maritime traffic (e.g. tank washing or leakage of lubricants) account for over 270,000 thousands of tonnes/year, ranking as the main anthropic input of oil into the marine environment. Vessel-related accidental spills (e.g. collisions, explosions) account for about 100,000 tonnes/year. The remaining amount is due to extraction operations and natural leakage. Although the number of accidental oil spills has decreased since the 80s, the volume of spills is variable and a function of the size of the tankers. The present tendency is to the increase of tanker size, leading to larger spills. CIMA has developed operational oceanographic modelling tools to assess and forecast oil spill accidents. These tools have been used to develop new oil spill risk approaches, based on dynamic risk maps. The work was developed in collaboration with large international consortia (e.g. FP7 ARGOMARINE and H2020 AtlantOS) and is being now extended to the entire Atlantic basin. Back tracking methodologies are also being developed to identify the origin of detected oil spills, allowing the identification of transgressors (e.g. in coordination with EMSA detections).

J. MARINE RENEWABLE ENERGIES

The hydrokinetic energy that can be extracted from tidal currents is one of the most promising new renewable energy sources. Tidal energy converters (TECs) are an energy generation technology that is currently at the pilot stage, with individual devices operating at a variety of sites around Europe's Atlantic coasts and the first array-scale deployments on track to be completed within two to three years. Tidal energy companies are today developing 2nd generation devices, i.e. more accessible, more efficient and potentially cheaper in order to drive down the unit cost of power and increase the number of potential deployment sites. This technology advance brings new challenges and opportunities, i.e. sites that were not considered to be attractive for TEC deployments due to the power output will become next targets for tidal energy exploitation.

The experience of device developers has been that one of the major obstacles to the continuing growth and maturation of the sector is the uncertainty surrounding the survivability, reliability and lifetime of TECs and their components. Also, major constraints for these future developments are the potential environmental impacts of extracting energy from highly dynamic and complex environments. There is a need for continuing investment in this area at this early stage in order to build the necessary confidence in the technology's performance and minimization of environmental impact that will allow for commercial scale developments to be realized in the future. CIMA carries out research on a wide range of marine phenomena. CIMA objectives in the field of marine renewables are to develop strategic data collection and analysis for potential viable resource areas using validated process based modelling tools; and initiate research into likely interactions between full-scale arrays and the marine environment in collaboration with tidal developers, research institutes and the European Marine Energy Center (EMEC).

K. THE FUTURE OF ATLANTIC INTERACTIONS

The North Atlantic Ocean is a maritime space shared by two continents whose economic potential is largely unknown and unexplored that shows increasing signs of ecological deterioration. Following the Galway declaration signed between EU, USA and Canada on the cooperation within the Atlantic Ocean to deepen the marine research knowledge in the Atlantic Ocean there is a need for an integrated marine policy to manage all maritime issues. Therefore, it is desirable that the scientific cooperation between Portugal and USA be fully committed in developing outstanding quality science and innovation to actively contribute for a more sustainable and better knowledge of the Atlantic Ocean space. CIMA are very committed to develop joint scientific projects in this ocean space.

Portugal depends upon a clean, safe and secure Atlantic Ocean and for this reason CIMA values international collaboration particularly within the Atlantic strategy and is fully committed to foster international cooperation with USA institutions with the aim to contribute for a more sustainable and effective Atlantic Ocean governance. Therefore, CIMA considers of particular importance the establishment of the Centre for Observation of the Atlantic, supported in this and other international partnerships or developed within the framework of Horizon 2020, with the objective of structuring joint research programs in cooperation with international networks dedicated to marine sciences in the Atlantic space. Within this cooperation CIMA would be particularly interested to develop joint research in the areas mentioned above but also in innovation strategies of the development of sensors to speed up the access to high quality data and on big data analysis.

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Networked vehicle systems for persistent Atlantic observations

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Currently there is a pressing need for a sustained, persistent, and affordable presence in the oceans that will help us to understand and monitor how key issues such as climate change, ocean acidification, unsustainable fishing, pollution, waste, loss of habitats and biodiversity, shipping, security, and mining are affecting global ocean sustainability and stewardship (IOC/UNESCO, 2011). This is not an easy endeavor. First the oceans cover 71 per cent of the Earth and contain 96 per cent of the Earth's living space thus making ocean observation a problem at the planetary scale. Second, the oceans are still largely inaccessible, not only to humans but also to man-made devices. Third, the oceans are a communications challenged environment: land-based communications have limited range and satellite communications are quite expensive. Fourth, although ships have been the mainstay of seagoing ocean sciences, a ship can only be at one place at a time, can only carry a small number of scientists, and can only stay at sea for so long (James G. Bellingham, 2007). In addition, ship time is very expensive. Fifth, the interior of the ocean changes faster than we can measure it with traditional sampling devices, such as ship borne sensors and drifters.

A sustained, persistent, and affordable presence in the oceans requires innovative approaches to systems development, operations, and management. This can only be achieved with an incremental and multi-dimensional approach. First, we need to increase the numbers of systems (buoys, drifters, floats, etc.) in operation in the oceans, and to develop and deploy fleets of robotic vehicles for ocean observation with unprecedented spatial and temporal resolution. Second, we need to network existing systems and new robotic vehicle systems for coordinated adaptation to observational needs. This entails being able to command and control networks of manned and unmanned vessels which, in turn, may form ad-hoc communication networks allowing for extended and cost-effective communications coverage. Observe that most systems at sea today lack basic networking capabilities. These capabilities would allow, for example, commercial ships to act as opportunistic sensor and communication platforms, as well as data mules ferrying data collected by other systems that they may encounter at sea. Third, we need new organizational frameworks for managing and coordinating the system(s) of systems of ocean observation that will result from these networking trends and associated cost benefits. This poses unprecedented technological and organizational challenges to countries and international organizations. Some efforts are underway to address these challenges. For example, a network of national observatories is being coordinated to provide ocean data for the Global Ocean Observing System (GOOS, <http://www.ioc.goos.org>). Many observatories are surface or seafloor moorings with sensor arrays. Where moorings are cabled to shore for power, a few observatories include buoyancy gliders as observing system components. Discussions have been underway to further develop Integrated Ocean Observing Systems (IOOS) which also include propeller-driven AUVs, ASVs, and UAS. These networking concepts are applicable to other domains such as surveillance and maritime security, where the role of networked vehicle systems becomes even more relevant (Philip McGillivray, 2012).

HISION

The vision of the University of Porto's Laboratório de Sistemas e Tecnologias Subaquáticas (LSTS) for persistent Atlantic Ocean observations is outlined to provide the framework within which networked vehicle systems are being developed at LSTS. First, the LSTS is briefly described with special emphasis on LSTS' vision for persistent ocean observations and interdisciplinary cooperation. Second, LSTS' underwater, surface, and air vehicles are described in the framework of the LSTS' development process in which vehicles share hardware and software environments to enable seamless network operations. Third, the LSTS open source software tool chain for mixed-initiative control of unmanned ocean and air vehicles operating in communications challenged environments is briefly presented. The software tool chain supports inter-operated underwater and radio communication networks, disruptive tolerant networking protocols, interoperability protocols, uniform command and control framework, and on-board autonomy. Fourth, current LSTS system's capabilities are described with reference to large scale field experiments. Current capabilities include coordinated ocean and air observations, 24/7 persistence, adaptive sampling, persistent fish tracking, and data mulling. Large scale field experiments include the annual Rapid Environmental Picture Atlantic exercise jointly organized, since 2010, by the Portuguese Navy and LSTS. The sixth edition of this exercise took place in July 2015 in the Azores Islands, Portugal, in cooperation with IMAR-DOP, University of Azores. The exercise had participants from the United States of America, NATO, Norway, United Kingdom, and Sweden operating over 20 autonomous underwater, surface, and air vehicles from an oceanographic ship from the Portuguese Navy and from vessels from the University of the Azores. Finally, future capabilities under development at LSTS are briefly outlined. These capabilities include launch and recovery from fixed and mobile platforms (including manned helicopters and submarines), smart data and sample collection, aerial recovery of objects from the ocean, migration of code over intermittent communication networks, integrated fish tracking and ocean observation, and distributed decision making for dynamic groups of vehicles. These capabilities are being developed in close cooperation with marine biologists from CIBIO-UPorto and oceanographers from CIIMAR-UPorto.

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i Underwater Systems and Technologies Laboratory

Towards an Observatory for Deep sea and Open Ocean Science in the Azores

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Summary

Portugal and the Azores have the great and unique potential to be a test-bed area for open ocean and deep-sea marine research. The proximity and accessibility to the different ecosystems render the Azores region a unique and strategical position in the middle of the Atlantic Ocean for ocean observation systems and research on ocean-atmosphere interaction and other climate change related issues.

Humanity now faces the evident signs of profound impacts of climate change in the oceans. This comes with a growing awareness of the added value of biodiversity.

This awareness brings new social and economic opportunities and is looked as capable of fostering great new scientific, technological and governance developments. This document discusses some of the challenges and research ideas that this oceanic research center could address.

1 The context

Portugal and the Azores have the great and unique potential to be a test-bed area for open ocean and deep-sea marine research. The Azores EEZ covers about 1M km², of which about 99d is deep sea, with more than 450 seamounts, several known hydrothermal vent fields, deep fracture zones and trenches, deep and isolated holes and basins, and a considerable extension of the MAR and abyssal areas. It sits over the Azores Triple Junction (ATJ) where the North American, Eurasian and African tectonic plates meet with an average depth of 3000 meters. High diversity and deep-sea ecosystems and habitats are hosted by the ATJ, undoubtedly one of the most interesting and singular areas on the planet.

The proximity and accessibility to the open ocean and to the different ecosystems of the deep sea render the region a unique and strategical position in the middle of the Atlantic Ocean for ocean observation systems and research on ocean-atmosphere interaction and other climate change related issues. The Azores is the perfect spot to study patterns and processes of oceanic functioning and biodiversity at multiple scales, from bacteria do top

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³ Guest scientist at WHOI

predators, but relevant to the Atlantic basin (amphi-Atlantic population connectivity), and large scale migrations. The location of the Azores at the boundary of large scale geographical provinces further offers the possibility of producing tangible scientific discoveries over this patchy environments of deep-sea and open ocean large migratory animals and other organisms, hardly accessible elsewhere.

Most of the area has yet to be explored and the potential of discovering new species, or unique deep-water habitats is very high. Recent findings in the AZ area include the discovery of new hydrothermal fields. More than 160 species of deep-water corals as well as an impressive number of deep-water sponges were recorded in this area, including species new to science, and the knowledge of neglected fauna, such as the meiofauna and microbes of the deep seafloor.

The perfect location of Faial and its oceanic harbor of Horta, from where easy and fast access to those environments and organism provide unique research opportunities, has nurtured the development of a local culture of marine research and education embodied in the Department of Oceanography and Fisheries of the University of the Azores (DOP), and the research Centers that developed thereafter: the Institute of Marine research (IMAR), the Associated Laboratory for Systems and Robotics (LARSys), and the Marine and Environmental Sciences Centre (MARE).

For over three decades this cluster developed a wide range of national and international cooperation with key players across both sides of the Atlantic, creating the backbone for an international research Centre focusing on the science and challenges of the deep-sea and the open ocean.

It pioneered the implementation and development of long term monitoring of the MAR vent fields since the 90's based on a strong strategic link to IFREMER and other partners across the Atlantic like WHOI, UHarvard; etc. The development of the existing infrastructures was achieved through out several European projects, and a European consortium created one of the very few existing infrastructures for long time observation in the deep-sea on a hydrothermal system context, and there are ongoing efforts to expand this observatory to seamounts under the EMSO (European Multidisciplinary Seafloor and water column Observatory) membership of Portugal. It has also fostered opportunities to track and study the behavior of a wide range of marine predator taxa (cetaceans, turtles, seabirds, sharks, fishes and squids) since the advent of marine biotelemetry in the 80's, in close collaboration with partners in the US (e.g. WHOI, NOAA, UH. The cluster research team also runs several regional monitoring programs for fisheries and conservation since 90's, including fisheries independent annual surveys of the relative abundance of coastal, demersal, and deep water fishes, from the islands' shores and shelves down to the 1200 m depth, and dedicated surveys of threatened megafauna (e.g. whales and dolphins, seabirds, marine turtles). These long time series are unique and a relevant source of information for biological studies as well as to support fisheries management and conservation, and serve as a baseline data for climate change and other long-term ecosystem studies.

The cluster has participated in multiple key international networks, including CoML, MARBEF NoE and the MARBEFe, EUROMARINE, ESONET NoE, EMBRC-PT (European Marine Biological Research Centre), NEREUS (Network of European Regions Using Space Technologies and MARS (Marine Association of Research Stations). Researchers based at IMAR-UAz also collaborate and participate in international organizations such as ICES, ICCAT, OSPAR, European Association of Science Academies, European Marine Board, EurOcean, etc. It has developed key unique facilities that fostered the visit of international scientists to cooperate and develop cutting edge science and technological developments, including:

- The unique laboratorial set-ups Deepsea Lab, combining a facility to study deep-sea animals from hydrothermal vent systems that recreates some of the key energy feeding sources, with an experimental laboratory to research scenarios of climate change on deep-sea organisms (e.g. increased temperature and pH on cold water corals).
- A pressurized vessel with 20 liters' capacity that can simulate depth to 4000 meters to conduct cutting edge studies on the effect of scenarios under pressure.
- The multi-instrumented permanent deep-sea observatories – EMSO, the hydrothermal vent observatory and the Condor observatory, located in the first seamount marine reserve for scientific purposes. profiting from the Condor seamount observatory experience it was structured

- a unique island-seamount deep-sea array of acoustic receivers for the tracking and monitoring of marine animals, integrating the global Ocean Tracking Network (OTN),

Importantly, the cluster has been participating with European and North-American partners in multiple technological projects to develop new robots, vehicles and sensors, providing the challenging scenarios required to test this emerging technology in real oceanic conditions. These collaborations have placed it as the national reference (expressed in the LARSyS top classifications by the Portuguese Science Foundation - FCT) as well as an international reference for testing oceanic scientific instruments and platforms.

2 The challenge

Humanity now faces the evident signs of profound impacts of climate change in the oceans, some of which may be irreversible, and of the limits to the concept of the oceans as an 'eternal sink'. This comes with a growing awareness of the added value of biodiversity together with that of the urgent need to promote good environmental status to secure the vital ecosystem services that the oceans provide, like the regulation ones such as nutrient regeneration, carbon sequestration, biological regulation, bioremediation, habitat provision; to the provision ones like fisheries, oil and gas, mineral resources, and biotechnological products.

This awareness brings new social and economic opportunities and is looked as capable of fostering great new scientific, technological and governance developments. Meeting these challenges requires an improvement in the way we work and look at the ocean. An effective conservation and sustainable use of the oceans and blue growth will necessarily change from words to actions.

At the core of this paradigm is the need to provide new and improved technologies that can provide access to critical scientific knowledge while constituting a self-growing technological advancement. We claim that a new international research Centre ensuring this symbiosis, expanding upon the existing expertise and facilities, may become a reference in open ocean and deep sea science globally, and a unique place to learn, develop, teach, and discover. The Centre could meet several priority challenges:

Climate change

Two main areas should be targeted. Firstly, study species that provide natural carbon sequestration (eg. The cold water corals in the deep-sea bed, the plankton in the ocean's water column) both in situ and experimentally, and develop key environmental indicators (e.g. of acidification effects) and develop the adequate mitigation and restoration strategies. Second, explore in depth the potential to use highly migratory top predators that visit the Azores MAR (e.g. whales, seabirds, sharks and fishes) as proxies to detect and forecast the effects of climate change (e.g. temperature rise, minimum oxygen zones) using a top-down approach across the food chain. This requires development of improved automated sensors and observatories to understand the interaction atmosphere and deep-ocean and its impacts on biological processes mediated by the seawater chemistry.

Sustainable use of the sea

To understand and predict the effects and impacts of climate change and human uses we first need to understand environmental dynamics and natural variability. The Azores MAR region profits from long term observations made either at seamounts (Condor) and hydrothermal vent fields (EMSO-Azores observatory), two habitats very likely to be directly and indirectly impacted by human activities. A continuous and improved study and monitoring of these habitats is critical as is the development of new capacities for open ocean monitoring, and will promote best-practices for the many baseline and environmental impact assessment studies that cannot cope with long term observations. Such an increased marine observation and instrumentation also requires a substantial increase of at-sea capacity. The Centre should therefore host visiting oceanographic vessels that could use the Azores to

test and apply observing technology in marine remote and extreme environments, including vehicles, robots and sensors, thus also fostering international cooperation across the Atlantic and the blue growth agenda.

Food security

Long term observations provide a unique opportunity to detect problems as they happen, including those jeopardizing food security. Monitoring and forecasting marine pollution and its impacts and assimilation by the food chain, from micro plastics to oil spills and heavy metals from atmospheric sinkage or deep-sea mining, is becoming a critical issue for the ever growing need of marine products for human consumption. The more than probable future exploitation of the largely untapped pelagic biomass thought to be available in the open ocean requires a very careful and conservative study and evaluation, and the Azores MAR may provide a key contribution in this perspective.

Conservation of marine biodiversity

Preserving our ocean's biodiversity requires the acquisition of critical knowledge to answer the questions of i) what is out there (i.e. the patterns in temporal and spatial dimensions), ii) how does it function (i.e., the processes in interaction with the environment) and iii) which services does it provide (i.e., the functional links to ecosystem goods and services and, ultimately, to human populations). Much is yet to be done globally but certainly much more with regards to the biodiversity of deep-sea and open ocean ecosystems. The unique expertise and at-sea research capacities on these environments that the Centre may host offers a great opportunity to study and promote the conservation of its associated biodiversity. This can be achieved both via the support to specific decision making processes as well as through promoting societal environmental awareness, e.g. by using charismatic megafauna as flag study species and by sharing ocean discovery tales.

Oceanic Governance

Coordinated governance for integrated world strategies for off shore and high seas in national and international waters for the sustainable use of the oceans. Relevant Azores Research Institutes were pioneer in using spatial management for conservation, and are involved in the establishment of the Azores Marine Park. These teams collaborate with international relevant marine conservation initiatives namely at the CBD, the Sargasso Sea Alliance, the OSPAR convention.

3 – The Centre

The proposed Centre for ocean observation and research thus emerges as a key, strategic tool to strengthen both Portugal's and the international capacities for scientific research on the open ocean and deep sea. It will help meet present and future challenges identified by national and international policies, and contribute to the blue growth agenda, to the sustainable use and preservation of the Atlantic Ocean, and to implement and promote observation and monitoring of the open ocean and deep-sea ecosystems.

The Centre shall therefore aim to:

- i) Promote and implement observation and monitoring of the open ocean and deep-sea;
- ii) Increase knowledge on the functioning of open ocean and deep-sea ecosystems;
- iii) Promote the oceans' sustainable use based on an ecosystem approach to management;
- iv) Foster marine technological development.

The expertise of the Centre is expected to produce important societal answers to themes like climate change, ecosystems structure and function, ecological processes, and human impacts (mining, fisheries, biotechnological prospecting, pollution), ecological modeling. This knowledge could be applied on ecosystem management and marine spatial planning and provide the tools to accomplish the Good Environmental Status required by the EC Marine Strategy Framework Directive and other International commitments. The Centre is expected to play a key role as a platform for testing and sharing at-sea research facilities (from sensors to ships, from AUVs to ROVs and HOVs). The Centre will also contribute for the increase in mobility of qualified scientists across both sides of the Atlantic and beyond through collaborative research projects and consortia, but also by developing cooperative training programs (e.g. graduate studies programs involving UAz and other Portuguese, European and US universities) that can competitively attract students.

RESEARCH AREAS

Key research areas in the Centre in cooperation with both sides of the Atlantic include:

1 Climate change impacts on biodiversity: a) to assess the potential effects of climate change on the physiology, behavior, population dynamics and distribution of selected key species (from microbes to megafauna) under different scenarios of greenhouse gas emissions; b) to evaluate the role of climate change in increasing the uncertainty in species stock assessment models, ecosystem based models, species resilience and restoration capacity. Forecast and mitigation.

2 Sustainable use of the environment: Impact assessment, mitigation and restoration; a) study the relevant ecosystem goods and services that will be affected by human use impacts; b) study the impact of bottom and pelagic fishing gears and propose measures to mitigate its adverse impacts; c) study the impacts of sediment plumes resulting from deep-sea mining on the physiological condition of species in the benthic and pelagic realm and on ecosystem functions, goods and services; d) evaluate and test active and passive restoration of deep-sea ecosystems already or threatened to become degraded, damaged or destroyed; d) developing innovative science for stock assessment on complex, data-poor oceanic environments such as the open ocean and deep-sea remote and fragmented habitats (islands, seamounts), where spatial distribution and connectivity pathways are different and required specific approaches; development and application of EBAM.

3 Ecosystem and spatial modelling a) develop ecosystem models and critically evaluate those models with respect to its role in ecosystem-based management; b) conduct simulations to explore and quantify the effect of different management scenarios in the whole ecosystem; c) to determine robustness of management scenarios

to uncertainties such as climate variability and climate change; and d) to develop spatially-oriented ecosystem based management to address the cumulative effects of multiple human uses of the marine environment.

H Marine biotechnology - continue bioprospecting efforts to mine organisms for genes and for products extracted from marine species, particularly those living in extreme environments under the influence of hydrothermalism conditions.

I Conservation, socio-economics and governance; a) further develop a framework for applying the Convention on Biological Diversity (CBD) Ecologically or Biologically Significant Marine Areas (EBSAs) criteria to locate potential ecologically or biologically significant areas in the open ocean and deep-sea environments; b) inform decision makers and other stakeholders on the implementation of an integrated ecosystem-based management.

RESOURCES NEEDED:

Five major components are needed to accomplish the open ocean and deep-sea challenges that this document describes.

1 Land based facilities such as laboratories, experimental stations and monitoring stations

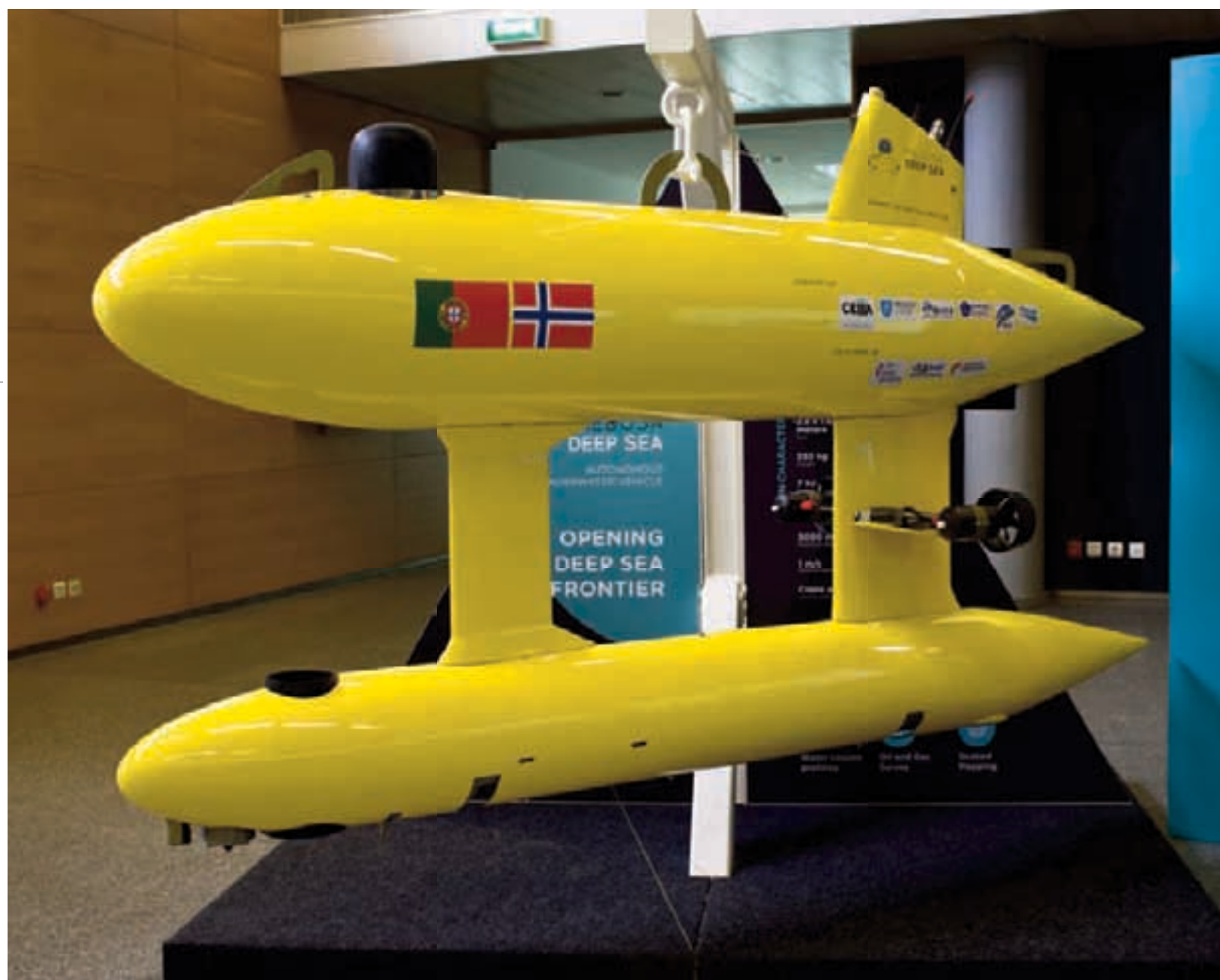
2 Remote platforms such as vessels, satellites and underwater robots

3 Deep-sea and open ocean long term fixed point observatories. The strong cooperation and strategic link with EMSO France shall be maintained and incorporated on the observatory.

Equipment such as sensors, instrumentation; and data-centers

I Human Resources-It is necessary to secure and reinforce the high skilled critical mass to secure the continued development of the research lines. This human resources are also needed to explore, operate and maintain the facilities and participate in monitoring, research and education.





Towards a transatlantic research agenda on Climate Change, Space and Oceans, centered in Azores

Tiago Rebelo e José Rui Felizardo

CEIIA, Engineering and Innovation CentreI

This document is intended as an initial contribution from CEIIA regarding the establishment of a new research agenda between Europe and the United States to unleash the potential of deep sea and deep space exploration, together with creating a framework to cope with climate change.

This first piece will focus on (1) the framework for setting such an agenda, its underlying assumptions and mechanisms, and (2) puts forward some of the technological challenges being targeted by CEIIA.

1. SETTING UP THE AGENDA

An agenda targeting intersections

Defining a common agenda for Space, Oceans and Climate change requires looking both at the commonalities and the complementarities of these fields of application.

Within these three areas, two categories emerge, the exploration and monitoring of new worlds at sea and space, and the understanding of a global dynamic of change (in climate) in our planet and the preparation of actions to cope with it.

Space and Oceans have relevant operational commonalities, since they account for virtually unexplored environments that are extreme and hostile to humans, and where operations face communication lags and require increasingly autonomous systems. Exploration needs to be based on systems that are able to withstand very high or very low pressures, corrosion or radiation, and that evolve towards increased resilience, adaptability and autonomy.

Several technological domains are cross-cutting to these areas and these intersections make room to learn from for cross pollination between them.

Targeting complexity and giving time

Achieving a balance between competition and cooperation, to have an agenda focusing on the latter, requires understanding the articulation of time and complexity for each challenge to be defined.

The scale of the proposed endeavor (a transatlantic research agenda), engaging world leading policy makers, users, companies, research centers, research agencies and regulators, enables this agenda to target broad and extremely complex challenges that cannot be adequately tackled in the existing siloed transatlantic innovation frameworks.

Challenges focused in the short-term and with reduced complexity will tend to foster only competition (and not cooperation) since there is a reduced level difficulty, drive and time to foster cooperation.

Challenges that focus on the long term and are complex enough, allow fostering cooperation among players that operate in a common market or operational scenario, many times as competitors. Therefore, aiming at novel solutions targeted at the medium and long-terms provides room and time to prepare for cooperation and make use of complementarities.

Giving the necessary time to foster cooperation also enables reinforcing stakeholder engagement processes. All the three themes require multi-stakeholder environments to be adequately dealt with. These include policy makers, researchers, innovators, business makers, users and the general public. Understanding the assumptions, drivers and boundary conditions of each of them is critical for success. People and processes need to be put in place to create the necessary levels of trust between stakeholders, ensure accountability and transparency, as well as the conditions to be consequential in the implementation of the agenda. Even being a bottom-up agenda, it will require top-down challenges.

Application driven

A comprehensive research agenda comes usually at the crossroads of technology and application, the approach being iterative because technology unleashes applications and new applications call for technology.

Considering the research agenda will target the development of technology to enable new applications in Oceans, Space and Climate change, it is understood by CEIIA as being, essentially, an application driven agenda, not forsaking the pushing force of technology in enabling new applications.

Users or operators of Oceans and Space, together with business makers, have in this context a critical role in providing operational pull for the agenda.

Identifying applications provides a focus for technology development and learning processes, bridging research with operations and markets, to allow for a stronger engagement from industry and users.

The fast pace of technical change, tied up with the learning process stemming from further exploring Oceans and Space requires continuously revisiting existing and potential application scenarios that call for disruptive solutions. In this scope this research agenda could encompass a think tank role for such purpose, leveraging the pivotal position of Azores in between the two most developed innovation ecosystems in the World.

Accelerating learning

This agenda can allow for accelerating individual and collective learning processes in both sides of the Atlantic.

Acceleration comes from increased interaction and exposure to international settings, different projects and initiatives, providing the space to deepen disciplinary knowledge and identifying inter- and transdisciplinary linkages.

Frequent in person interactions, complemented by today's virtual relation tools, seem critical to this end and should, therefore, be an important part of this agenda.

Without countering the application focus of the agenda, encompassing serendipity requires also to allow for open end interactions focused on technology and knowledge building processes that may not be yet related with one specific application.

2. TECHNOLOGICAL CHALLENGES AND THE CONTRIBUTION OF CEIIA

Application-wise CEIIA is particularly interested in developing engineering systems for sustained, sustainable and cost-effective manned and unmanned operations in Ocean and Space.

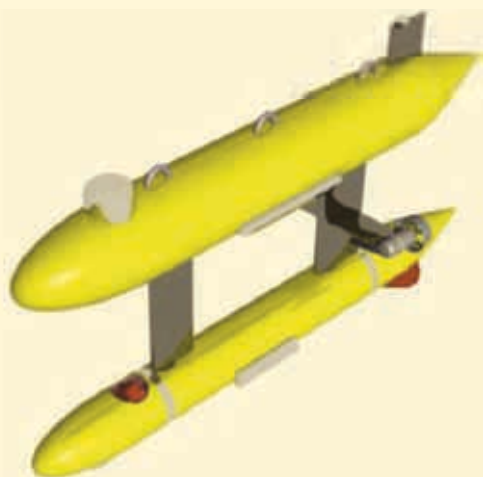
These operations are related to exploration (discovering and characterizing new areas) and environmental monitoring, which is increasingly required to allow for adequate governance of continental shelves and the deep Ocean as well as to monitor exploitation activities in oil and gas, or other sea-based resource exploration.

This focus results from CEIIA's recent evolution, leveraged on project-based learning processes with two important dynamics, one of specialization to allow approaching increasingly complex challenges and other of diversification, to value capacities in new applications and harvest the benefits of cross pollination among different fields of application.

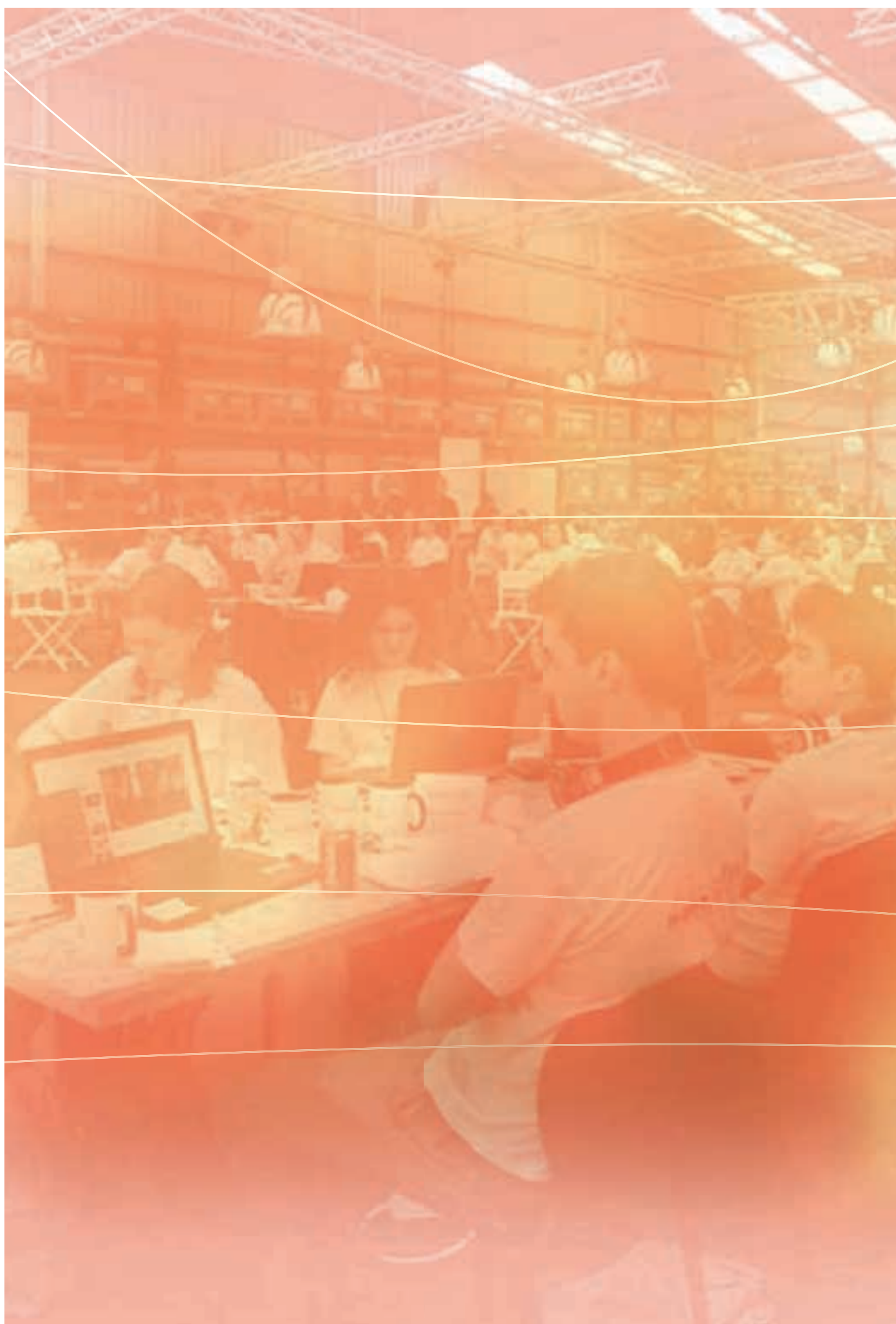
In this context, CEIIA's approach to engineering new systems to explore Space and Oceans builds on the experience in developing structures and then vehicles for the automotive and aeronautical industries.

Challenges being targeted by CEIIA are related to the development of new, robust, reliable and networked devices to explore and monitor with increased effectiveness and efficiency Oceans and Space. For these systems, CEIIA is looking into:

- Advanced structures and materials to enable sustained manned and unmanned operations in Oceans and Space.
- Integration of structures and systems in new vehicles and equipment for novel applications.
- Management of networks of devices, sensing and actuating on the environment. Examples of technological focuses from CEIIA are:
 - New development methodologies for structures and vehicles, integrating new computing capabilities to allow for a multiscale static and dynamic analysis of new materials and structural concepts.
 - Flexibility embedded in design of new products and systems to allow for operational resilience.
 - New composite and polymeric structures, with recyclable and natural materials for matrixes and reinforcements, able to withstand extreme pressure, temperature, corrosion and radiation conditions.
 - In situ low-cost, environmentally friendly and fast production processes.
 - Reliable and resilient control and automation from an integrator's perspective. MEDUSA deep sea AUV being developed by CEIIA, ISR Lisboa, IMAR, IPMA, EMEPC and ARGUS from Norway for ocean exploration at depths up to 3000m depth (project under the EEA Grants)



MEDUSA deep sea AUV being developed by CEIIA, ISR Lisboa, IMAR, IPMA, EMEPC and ARGUS from Norway for ocean exploration at depths up to 3000m depth (project under the EEA Grants)



Atlantic Interactions: a commitment to knowledge through global science and technology cooperation and science diplomacy

Paulo Ferrzo

President, Fundação para a Ciência e a Tecnologia

The sustainable development of the Atlantic and of the countries that it unites is critical to the future of humankind. This is related, for example, with the critical role of the Atlantic to global climate, namely through the production of deep waters on the subpolar gyre and the corresponding heat transport into the deep global ocean circulation (AMOC) and the uptake of anthropogenic greenhouse gases, especially carbon dioxide, into the ocean biogeochemical cycles. Both these processes are driven by surface air-sea fluxes on the North-Atlantic and depend on the upper ocean circulation, mixing and biogeochemical interactions.

This shows the critical relevance of an integrative approach to climate change and energy, earth and ocean sciences in the Atlantic, necessarily facilitated by the use of space science and technology together with emerging methods of data science, data visualization and science communication to better understand the emerging issues associated to climate change and the sustainable management of common resources.

As a consequence, promoting an international research agenda that enables this integrative approach - the Atlantic Interactions - constitutes a new initiative to unleash the potential of the Atlantic for society. This interdisciplinary research is critical to face today's challenges and the economic transitions, in particular environmental changes, security conditions, natural hazards, and other human dimensions, and calls for the design of an international partnership that aims for the sustainability for the Atlantic and related North-South / South-North cooperation.

The holistic and integrated approach of the Atlantic Interactions initiative, will require a very efficient collaboration between the research centers around the Atlantic, to effectively address the synergies between Space, Climate-Energy, Oceans and Data Sciences without duplicating the existing research agendas and effort. This provides the motivation for the creation of the Atlantic International Research (AIR) Center, as a coordinating organization that will enhance the potential of the existing Atlantic research infrastructures by combining several scientific areas, acting as a catalyst for research and innovation in multiple domains ranging from renewable energies, to the interactions of the ocean with the atmosphere and global climate phenomena, the impacts of global changes on the open ocean and the deep sea, including their biodiversity, as well as blue economy.

Portugal is assuming the leadership of this initiative with a great involvement of FCT, reinforcing its Atlantic traditions, by enhancing scientific development as a privileged mechanism to promote socio-economic development to all the Atlantic nations, including all those currently in the margins of knowledge driven societies and knowledge-based economic activities. This constitutes a great motivation for the days ahead.



INITIAL POLICY RESEARCH
WORKSHOPS
AND HIGH LEVEL MEETINGS



Climate Change and Energy, Space and Oceans

WORKSHOP

1

New York

June 10th 2016

WORKSHOP 1 • AGENDA

08:45 REGISTRATION

09:00 WELCOME

Allan E. Goodman, President and CEO - Institute for International Education, IIE, PT
 Paulo Ferrão, President of the Fundação para a Ciência e a Tecnologia (FCT), PT
 Manuela Bairos, Consul General - Portuguese Chancery in New York City, PT
 Manuel Heitor, Minister for Science, Technology and Higher Education – Portuguese Government

9:20 KEY-NOTE

The uncovered potential of the Azores as an International Research Center (“AIR Center”)

Eric Lindstrom, NASA, Co-chair of the International Global Ocean Observing System Steering Committee
 and Co-chair of the US Interagency Ocean Observations Committee (IOOC), USA
 Pedro Conceição, United Nations Development Program, UNDP

10:00 DATA SCIENCE AND ENERGY SYSTEMS FOR THE ATLANTIC

Co-Chairs

José Fonseca de Moura, Carnegie Mellon University, USA
 Bruce Tidor, Massachusetts Institute of Technology, USA

Participants

Juan Sanchez, University of Texas at Austin, USA
 Manuela Veloso, Carnegie Mellon University, USA
 Carlos Santos Silva, Instituto Superior Técnico – Universidade de Lisboa, PT
 Scott Van Broekhoven, MIT Lincoln Lab, USA
 Rui M. Ponte, Atmospheric and Environmental Research Inc., USA
 Soumya Kar, Carnegie Mellon University, USA
 Marija D. Ilic, Carnegie Mellon University, USA

11:30 ATMOSPHERIC SCIENCE AND CLIMATE CHANGE IN THE ATLANTIC

Co-Chairs

Miguel Miranda, President of IPMA - Portuguese Institute for the Sea and the Atmosphere, PT
 Sally McFarlane, ARM Program Manager, US Department of Energy, USA
 Eduardo Brito de Azevedo, University of the Azores, PT

Participants

Sally McFarlane, ARM Program Manager, US Department of Energy, USA
 Paulo Fialho, University of the Azores, PT
 Pavlos Kollias, Canada Research Chair in Radar Applications for Weather and Climate Research,
 Stony Brook University, USA
 Patrick Heimbach, University of Texas at Austin, USA
 John Cortinas, Director of the Office of Weather and Air Quality, NOAA, USA

12:40 WORKING LUNCH

13:15 SPACE SCIENCE AND SYSTEMS FOR THE ATLANTIC

Co-Chairs

Fausto Brito e Abreu, Azores Regional Secretary for the Ocean, Science and Technology, PT
 Robert Peterson, University of Texas at Austin, USA

Participants

Miguel Bélló Mora, Elecnor Deimos, Spain
 Sérgio Barbedo, Thales-Edisoft, PT
 Luís Santos, Regional Secretariat for the Sea, Science and Technology, PT
 Marco Bravo, University of Texas at Austin, USA

14:15 OCEAN SCIENCE AND TECHNOLOGY FOR THE ATLANTIC

Co-Chairs

Helder Silva, University of the Azores, PT
Eric Lindstrom, NASA, USA

Participants

Ana Colaço, University of the Azores, PT
Arthur Baggeroer, Massachusetts Institute of Technology, USA
Ned Dwyer, EurOcean
João Tasso, University of Porto, PT
Karl Stromssen, Global Maritime Group, NOR
Maria João Bebianno, CIMA, University of Algarve, PT
Ramiro Neves, Instituto Superior Técnico – Universidade de Lisboa, PT

16:00 SUMMARY

Towards an integrative approach to space, climate and energy, earth and ocean R&D in the Atlantic

Rapporteurs

Chairs of the Thematic Sessions

17:00 SUMMARY

Towards an integrative approach to space, climate and energy, earth and ocean R&D in the Atlantic

Paulo Ferrão, President of the Fundação para a Ciência e a Tecnologia (FCT), PT
António Rendas, Rector of Universidade Nova de Lisboa, PT
António Cunha, President of the Council of Rectors of the Portuguese Universities, PT
Manuel Heitor, Minister for Science, Technology and Higher Education - Portuguese Government

17:30 CLOSING**18:00 Networking, hosted by the Consul General - Portuguese Chancery in New York City**

LIST OF PARTICIPANTS IN THE WORKSHOP 1

NAME	ORGANIZATION
Ana Colaço	IMAR/MARE, University of the Azores
António Cunha	CRUP, University of Minho
António Rendas	Universidade Nova de Lisboa
Allan Goodman	Institute for International Education
Arthur B. Baggeroer	MIT
Bruce Tidor	MIT
Carlos Santos Silva	IST, Universidade de Lisboa, PT
Douglas Hart	MIT
Eduardo M. Azevedo	University of the Azores
Emir Sirage	Fundação para a Ciência e a Tecnologia (FCT)
Eric Lindstrom	NASA
Fausto Brito e Abreu	Government of the Azores
Francisco V. Cunha	CEIIA
João Tasso de Sousa	FEUP
José Fonseca de Moura	CMU
John Cortinas	NOOA
Juan Sanchez	UTAustin
Juan T. Hernani	Satlantis
Karl Stromsem	Global Maritime group
Luís Santos	Government of the Azores
Manuel Heitor	Minister for Science, Technology and Higher Education (MCTES)
Manuela Bairos	Portuguese Chancery in New York City
Manuela Veloso	CMU
Marco Bravo	IC2 Institute - UTAustin
Maria João Bebianno	CIMA /University of Algarve
Marija D. Ilic	CMU
Miguel Bélló Mora	Elecnor Deimos
Miguel Miranda	IPMA
Ned Dwyer	EuroOcean
Nuno Ávila	Deimos Engenharia
Patrick Heimbach	UTAustin
Paulo Chaves	ISQ
Paulo Ferrão	Fundação para a Ciência e a Tecnologia (FCT)
Paulo João de Lemos de Sousa Fialho	University of the Azores
Pavlos Kollias	ARM
Pedro Arezes	University of Minho
Pedro Conceição	UNDP
Ramiro Neves	IST, Universidade de Lisboa, PT
Robert A. Peterson	IC2 Institute - UTAustin
Rui M. Ponte	Atmospheric and Environmental Research Inc
Sally McFarlane	US Department of Energy
Scott Van Broekhoven	MIT
Sérgio Barbedo	Ediso0
Soumya Kar	CMU
Teresa Ferreira	University of the Azores

Climate Change and Energy, Space and Oceans

WORKSHOP

2

Ponta Delgada, Azores

June 27th 2016

WORKSHOP 2 • AGENDA

08:45 REGISTRATION

09:00 WELCOME

Manuel Heitor, Minister for Science, Technology and Higher Education – Portuguese Government
 Vasco Cordeiro, President of the Regional Government of the Azores
 Ricardo Serrão Santos, Member of the European Parliament
 João Luís Gaspar, Rector, University of the Azores, PT
 António Cunha, President of CRUP, PT
 Fausto Brito e Abreu, Azores Regional Secretary for the Ocean, Science and Technology, PT

9:30 SUMMARY: PRIMARY ORIENTATIONS OF THE 1ST WORKSHOP, JUNE 10 IN NEW YORK

Paulo Ferrão, President of the Fundação para a Ciência e a Tecnologia (FCT), PT

10:00 KEY-NOTE SPEAKERS

Dan Stanzione, UT Austin , USA
 “iAtlantic: e-science/cyber infrastructure for data management at AIRC”

Tiago H. Silva and Rui L. Reis, kBG Research Group, ICVS/kBG, University of Minho, PT
 “Valorization of marine resources and by-products for high added-value applications in the biotech, pharma, biomedical and regenerative medicine sectors”

João Luís Gaspar, University of the Azores , PT
 “Geophysics and earth Dynamics in the Atlantic – observing vulcans in the Azores”

11:00 COFFEE BREAK

11:30 - 13:30 PARALLEL SESSIONS ▯ THEMATIC WORKING GROUPS ▯ VENUE: SCIENTIFIC COMPLEX ROOMS

Data Science, Energy Systems, Atmospheric Science and Climate Change in the Atlantic

Chair:

Fausto Brito e Abreu
 Space Science and Systems for the Atlantic

Chair:

Robert Peterson
 Ocean Science and Technology for the Atlantic

Chair:

Helder Silva

Bruce Tidor, MIT
 Carlos Santos Silva, IST
 Douglas Hart, MIT
 Eduardo Azevedo, UAzores
 João Luís Gaspar, U Azores
 Juan Sanchez, UTAustin
 Miguel Miranda, IPMA
 Paulo Fialho, UAzores
 Pedro Arezes, U. Minho
 Ronald G. Prinn, MIT
 Soumya Kar, CMU
 Teresa Ferreira, U Azores
 zong-Liang Bang, UT Austin
 João Barbosa, UTAustin
 Eduardo Nunes, Embraer
 Imaculada Serrano, Deimos
 Juan Tomas Hernani, Satlantis
 Marco Bravo, UT Austin

Miguel Bello Mora, Deimos
 Nuno i vila, Deimos
 Paulo Chaves, ISQ
 Ricardo Conde, Edisoft
 Ricardo Mendes, Tekever
 Sergio Barbedo, Edisoft
 Sérgio Carvalho, Embraer
 Tiago Pardal, Omnidea
 António Cândido. IH
 Arthur Baggeroer, MIT
 Filipe Castro, CIIMAR
 Filipe Costa, UMinho
 Francisco Cunha, CEIIA
 João Tasso, LSTS, UP
 José Mesquita Onofre, IH
 Kristin Thorud, RCN
 Luis Menezes Pinheiro, UAveiro
 Maria João Bebianno, CIMA
 Marina Cunha, UAVEIRO
 Ramiro Neves, MARETEC
 Rui Reis, k BQ Research Group
 Tiago P. Cunha, F. Oceano Azul
 Tiago Silva, k BQ Research Group

** 5 minutes presentations for new participants*

13:00 LUNCH

14:30 PLENARY SESSION

Filipe Costa, University of Minho, PT

"Azores and new generation environmental and biodiversity monitoring"

Kristin Thorud, Research Council Norway, NO

"Joint Programming for healthy and productive Seas – JPI Oceans"

Ronald R. Prinn, MIT

"Benefits of a world-class Climate and Greenhouse Gas Observatory in the Azores"

zong-Liang Bang, UT Austin

"An earth system modeling approach to understanding climate, energy, water, and the environment"

Tiago Pardal, Omnidea

"Azores – a gateway to Space"

Ricardo Mendes, Tekever

"UAS and Satellite Constellations as a multi-purpose infrastructure for Atlantic Exploration"

Eduardo Nunes, Embraer

"Embraer"

Piero Messina, ESA

"European Space Agency"

16:30 COFFEE BREAK

16:45 PLENARY SESSION

Towards a research agenda for the establishment of an International Research Center ("AIR Center")

Rapporteurs – Chairs of the parallel sessions

Discussion and Q&A

17:30 CLOSING SESSION

Rui Amen, Director of the Operational Program for the Azores, PT
 Ricardo Serrão Santos, Member of the European Parliament
 Elizabeth Konick, Principal Officer US Consulate in Ponta Delgada and Consul, US
 Raquel Franco, Administradora da Sociedade para o Desenvolvimento Empresarial dos Açores, SDEA, PT
 Manuel Heitor, Minister for Science, Technology and Higher Education, PT

18:00 CLOSING**20:00 DINNER**

LIST OF PARTICIPANTS IN THE WORKSHOP 2

NAME	ORGANIZATION
Ana Quartin	IFundação para a Ciência e a Tecnologia (FCT)
António Cunha	CRUP
António M.C. Coelho Cândido	Instituto Hidrográ. co
Arthur B. Baggeroer	MIT
Benjamim Rockwell	US Portugal Embassy
Bruce Tidor	MIT
Carlos Santos Silva	IST, Universidade de Lisboa, PT
Carolina Rêgo Costa	Ministry of Science, Technology and Higher Education (MCTES)
Dan Stanzione	UTAustin
Douglas Hart	MIT
Eduardo Brito de Azevedo	University of the Azores
Eduardo Nunes	Embraer
Elizabeth Konick	US Consulate in Ponta Delgada
Emir Sirage	Fundação para a Ciência e a Tecnologia (FCT)
Fausto Brito e Abreu	Government of the Azores
Filipe Castro	CIIMAR
Filipe Costa	University of Minho
Francisco Cunha	CEIIA
Gabriela Queiroz	University of Azores
Gui Menezes	IMAR/MARE, University of the Azores
Helder Silva	IMAR/MARE, University of the Azores
Imaculada Serrano	Deimos
João Barbosa	UT Austin
João Luís Gaspar	University of the Azores
João Tasso de Sousa	FEUP
José M. Onofre	Instituto Hidrográ. co
José Manuel Baptista	Universidade da Madeira
Juan Sanchez	UTAustin
Juan T. Hernani	Satlantis
Luis Menezes Pinheiro	UAveiro
Luis Santos	Government of the Azores
Kristin Thorud	Research Council Norway
Kristin Vogford	Icelandic Meteorological Office

Manuel Heitor	Minister for Science, Technology and Higher Education (MCTES)
Marco Bravo	IC2 Institute - UTAustin
Maria João Bebianno	CIMA /University of Algarve
Marina Cunha	University of Aveiro
Megan Ihrie	US Portugal Embassy
Miguel Bélo Mora	Elecnor Deimos
Nemesio Perez	ITER
Nuno Ávila	Deimos Engenharia Portugal
Nuno Catarino	Deimos
Nuno SimBes	Uavision
Paulo Chaves	ISQ
Paulo Ferrão	Fundação para a Ciência e a Tecnologia (FCT)
Paulo Fialho	University of the Azores
Pedro Arezes	UMinho
Piero Messina	ESA
Ramiro Neves	IST, Universidade de Lisboa, PT
Raquel Franco	Sociedade para o Desenvolvimento Empresarial dos Açores, SDEA
Ricardo Conde	Ediso0
Ricardo Mendes	Tekever
Ricardo Serrão Santos	European Parliament
Rita Silva	Fundação para a Ciência e a Tecnologia (FCT)
Robert A. Peterson	IC2 Institute - UTAustin
Ronald Prinn	MIT
Rui Amen	Director of the Operational Program for the Azores
Sérgio Barbedo	Ediso0
Sérgio Carvalho	Embraer
Soumya Kar	CMU
Sue Loughlin	British Geological Survey
Teresa Ferreira	University of the Azores
Tiago Pardal	Omnidea
Tiago Pitta e Cunha	Blue Ocean Foundation
Tiago Silva	kBQ Research Group
Vasco Cordeiro	President of the Regional Government of the Azores
Zong-Liang Yang	UT Austin







Climate Change and Energy, Space and Oceans

WORKSHOP

3

Lisbon

July 4th 2016

WORKSHOP 3 • AGENDA

**Ciências e Tecnologias para o Atlântico - a interação entre a Ciência dos Dados,
o Espaço, as Mudanças Climáticas e os Oceanos**

17H00 INTERVENÇÃO INICIAL

Paulo Ferrão, Presidente da Fundação para a Ciência e a Tecnologia
Fausto Brito e Abreu, Secretário Regional do Mar, Ciência e Tecnologia, Governo dos Açores
Miguel Miranda, IPMA

18H30 ORADORES CONVIDADOS

Eric Lindstrom, NASA

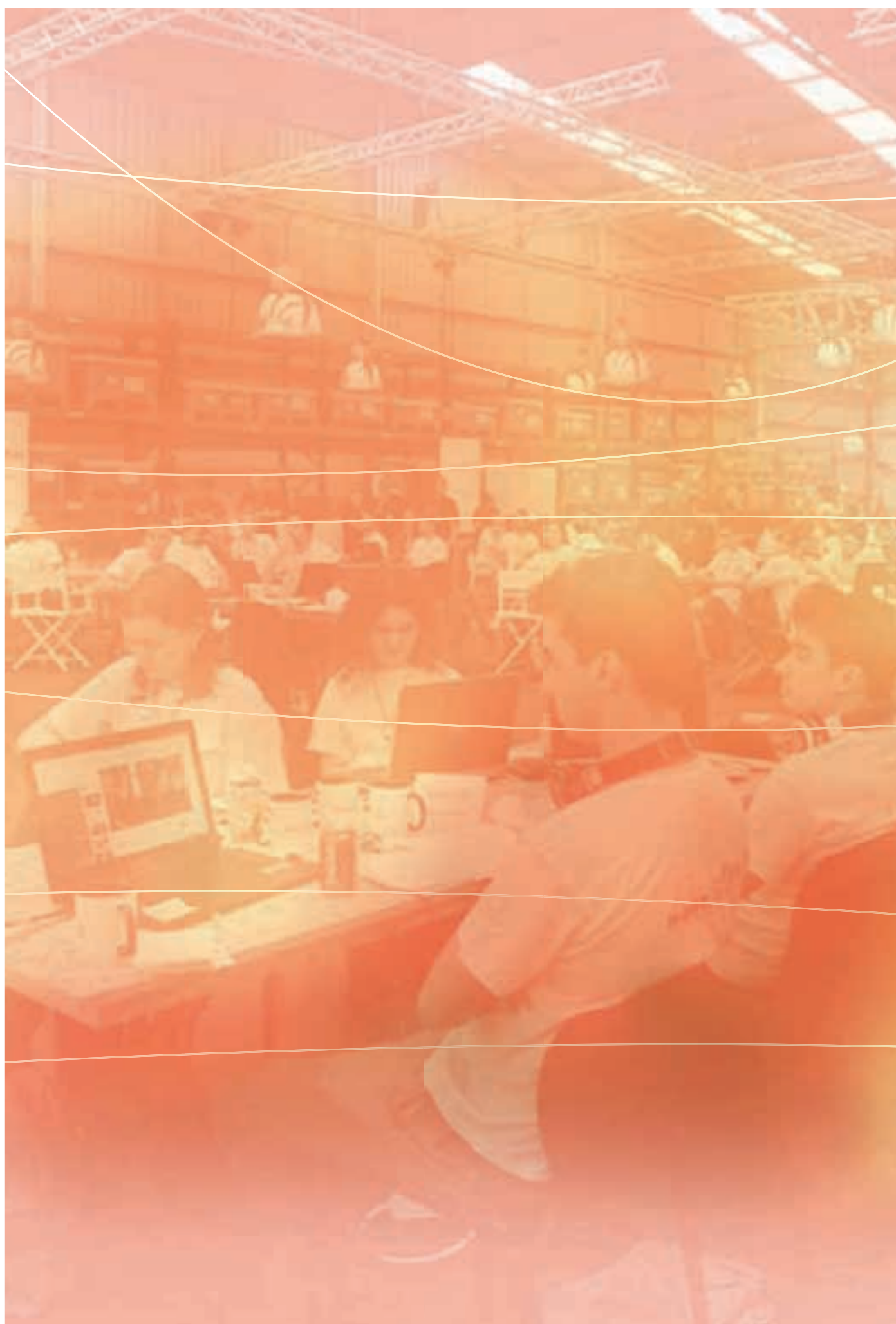
19H00 DIPLOMACIA CIENTÍFICA PARA O ATLÂNTICO

Robert A. Sherman, Embaixador dos Estados Unidos da América
Jeffrey Marder, Embaixador do Canadá
Mario Vilalva, Embaixador do Brasil
Orla Tunney, Embaixadora da Irlanda
Madalena Neves, Embaixadora de Cabo Verde

Intervenção final
João Pedro Matos Fernandes, Ministro do Ambiente
Manuel Heitor, Ministro da Ciência, Tecnologia e Ensino Superior







Climate Change and Energy, Space and Oceans

WORKSHOP

4

Paris

August 29th 2016

WORKSHOP 4 • AGENDA

Portugal Ministerial visit to ESA HQ and Azores related Workshop
August 29th 2016 - European Space Agency (ESA) Headquarters

14:00 ROUND-TABLE ON AZORES INTERNATIONAL RESEARCH bAIRcCENTER

Chairs

Franco Ongaro, Director of Technical and Quality Management - ESA
Paulo Ferrão, President of FCT

AIR Center: concept paper

Paulo Ferrão, President of FCT

ESA Programmes and the AIR Center

Franco Ongaro, Director of Technical and Quality Management

Thomas Beck, Directorate of Operations

Udo Becker, General Support Technology Programme

Simonetta Cheli, Directorate of Earth Observation

Flaminia Rossi, Directorate of Launchers

Contributions from the Portuguese R&D and Industry stakeholders

CEIIA, Critical Software, Edisoft, Elecnor Deimos, Faculdade de Ciências of the Universidade de Lisboa, GMV, Omnidea, Tekever, Universidade de Coimbra - IPN, Universidade do Porto

Questions for round-table guests (k questions for discussion)

- How can the AIR Center contribute to foster ESA activitiesP
- C hich products/services can industry and academia develop associated to the implementation of space transportation activities in the AzoresP
- C hich Earth Observation (EO) activities on Space and Oceans can be developed under the umbrella of the AIR Center during the next 5 years (2017-2022)P

16:30 RAPPORTEURS OF ROUND-TABLE

Piero Messina, Strategy Department - ESA

Paulo Ferrão, President of FCT

16:45 FINAL REMARKS

Fausto Brito e Abreu, Azores Regional Secretary for the Sea, Science and Technology, PT

Manuel Heitor, Minister for Science, Technology and Higher Education, PT

17:00 END OF MEETING

LIST OF PARTICIPANTS IN THE WORKSHOP 4

NAME	ORGANIZATION
Alberto de Pedro Crespo	IGMV
Álvaro Peliz	Faculdade de Ciências of the Universidade de Lisboa
Bruno Carvalho	Critical So0ware
Carlos Pires	Deputy Chief of Mission, Portuguese Embassy in Paris
João Tasso	Universidade do Porto
Elsa Alexandrino	Elecnor Deimos
Fausto Brito e Abreu	Azores Regional Secretary for the Sea, Science and Technology, PT
Flaminia Rossi	Directorate of Launchers - ESA
Francisco Cunha	Tekever
Franco Ongaro	Director of Technical and Quality Management - ESA
Luís Serina	Head of FCT Space Programme
Manuel Heitor	Minister of Science, Technology and Higher Education, PT
Miguel Bélló Mora	Elecnor Deimos
Paulo Ferrão	FCT President
Paulo Guedes	Critical So0ware
Piero Messina	Strategy Department - ESA
Simonetta Cheli	Directorate of Earth Observation - ESA
Teresa Mendes	Universidade de Coimbra - IPN
Teresa Tavares	Adviser to the Minister of Science, Technology and Higher Education, PT
Thomas Beck	Directorate of Operations - ESA
Tiago Pardal	Omnidea
Tiago Rebelo	CEIIA
Tiago Sepúlveda	Ediso0
Udo Becker	General Support Technology Programme - ESA



Climate Change and Energy, Space and Oceans

WORKSHOP

5

Parque Tecnológico de S. José dos Campos

September 5th 2016



LIST OF PARTICIPANTS IN THE WORKSHOP 5

NAME	ORGANIZATION
Anderson Ribeiro Correia	Reitor, Instituto Tecnológico de Aeronáutica - Departamento de Ciência e Tecnologia Espacial do Comando da Aeronáutica
Brigadeiro Augusto Luiz de Castro Otero	Diretor, Instituto de Aeronáutica e Espaço
Elsó Alberti Júnior	Diretor Técnico e de Operações, Parque Tecnológico de S. José dos Campos
José Antonio Filippo	Vice Presidente, EMBRAER
Luiz Antônio Tozi	Director, FATEC- S. José dos Campos
Manuel Heitor	Ministro da Ciência, Tecnologia e Ensino Superior
Marcelo Sáfadi Alvares	Diretor de Planejamento, Parque Tecnológico de S. José dos Campos
Peter Christian Hackspacher,	Coordenador Executivo do Instituto de Estudos Avançados do Mar- IEAMar, Universidade Estadual Paulista JI lio Mesquita Filho
Rui de Albuquerque	Senior Advisor , Centro Nacional de Pesquisa em Energia e Materiais (CNPEM)
Ricardo Magnus Osório Galvão	Diretor, INPE
Teresa Tavares	Ministério da Ciência, Tecnologia e Ensino Superior
Eduardo Bonini	Presidente, Visiona Tecnologia Espacial



Climate Change and Energy, Space and Oceans

WORKSHOP

6

Brussels, Portuguese Permanent
Representation to the European Union

September 19th 2016

WORKSHOP 6 • AGENDA

Atlantic Interactions: Knowledge, Climate Change, Space and Oceans

6th Workshop - 19 September 2016 - Portuguese Permanent Representation to the European Union, Brussels

13:30 REGISTRATION

14:00 WELCOME REMARKS: OPPORTUNITIES FOR ATLANTIC INTERACTIONS

Manuel Heitor, Minister for Science, Technology and Higher Education, Portuguese Government, PT

Nuno Brito, Ambassador, Permanent Representative of Portugal to the EU, PT

João Aguiar Machado, Director-General, Directorate-General for Maritime Affairs and Fisheries (DG MARE), European Commission

Jaime Silva, Adviser to the Director-General, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROU), European Commission

Mário Campolargo, Deputy Director-General, Directorate-General for Informatics (DG DIGIT), European Commission

14:30 INTRODUCTORY REMARKS: ATLANTIC AND THE AZORES INTERNATIONAL RESEARCH CENTER

Moderator

Paulo Ferrão, President, Fundação para a Ciência e a Tecnologia (FCT), PT

Ricardo Serrão Santos, Member of the European Parliament

Jean Jacques Dordain, Special Adviser, Ministry for Science, Technology and Higher Education, Portuguese Government, PT

João António Lorenzetti, National Institute for Space Research (INPE), BR

Ronald G. Prinn, Director of the Center for Global Change Science, Massachusetts Institute of Technology (MIT), US

15:00 THEMATIC DISCUSSIONS: CLIMATE CHANGE AND ENERGY, SPACE, OCEAN AND DATA SCIENCE

Moderator

Paulo Ferrão, President, Fundação para a Ciência e a Tecnologia (FCT), PT

Miguel Belló Mora, CEO, Elecnor Deimos, SP

Hélène Huby, Head, Innovation Management, Airbus Defence and Space, DE

Dan Stanzione, Executive Director of Texas Advanced Computing Center, University of Texas at Austin (UT Austin), US

Ned Dwyer, Executive Director, European Centre for Information on Marine Science and Technology (EurOcean)

Álvaro Peliz, Professor, Universidade de Lisboa (IDL-UL), PT

Karl Strömsen, Business Development Manager non-Oil&Gas, Global Maritime AS, NO

Carlos S. Silva, Professor, Universidade de Lisboa (IST-UL), PT

Teresa Ferreira, Professor, Universidade dos Açores (UAç), PT

Isabel Sousa Pinto, Professor, Universidade do Porto (UP), PT

16:45 AIR CENTER: AN INNOVATIVE INTEGRATED APPROACH

Paulo Ferrão, President, Fundação para a Ciência e a Tecnologia (FCT), PT

17:00 ROUND TABLE: ATLANTIC INTERACTIONS

Moderator

Paulo Ferrão, President, Fundação para a Ciência e a Tecnologia (FCT), PT

Tony Lewis, Emeritus Beaufort Professor, University College Cork (UCC), IR

João Lorenzetti, National Institute for Space Research (INPE), BR

Juan Sanchez, Professor, University of Texas at Austin (UT Austin), US

Isabelle Duvaux-Béchon, Head, Global Challenges and Partnerships, European Space Agency (ESA)

Sigi Gruber, Head, Marine Resources Unit, Directorate-General for Research & Innovation (DG RTD), European Commission

Fausto Brito e Abreu, Regional Secretary for the Oceans, Science and Technology, Azores Regional Government, PT

17:45 FINAL REMARKS AND WAY FORWARD

Manuel Heitor, Minister for Science, Technology and Higher Education, Portuguese Government, PT

Carmen Vela, Secretary of State for Science and Technology, Spanish Government, ES

Carlos Moedas, Commissioner for Research, Science and Innovation, European Commission

18:30 COCKTAIL HOSTED BY THE PERMANENT REPRESENTATIVE OF PORTUGAL TO THE EU IN BRUSSELS

LIST OF PARTICIPANTS IN THE WORKSHOP 6

NAME	ORGANIZATION
Agata Janaszczyk	Permanent Representation of Poland to the European Union
Alain Bories	OHB SE
Alberto Pedro	GMV Portugal
Álvaro Peliz	Universidade de Lisboa
Ana Colaço	Universidade dos Açores
Ana Quartin	Fundação para a Ciência e a Tecnologia
Ana Teresa Caetano	Directorate-General for Research & Innovation
Antonio Di Giulio	Directorate-General for Research & Innovation
António Pascoal	Universidade de Lisboa
António Santos Martinho	Instituto Hidrográ. co
Bruce Tidor	Massachusetts Institute of Technology
Carla Matias dos Santos	Directorate-General for Research & Innovation
Carlos Moedas	Commissioner for Research, Science and Innovation
Carlos Portugués Carrillo	Permanent Representation of Spain to the European Union
Carlos Santos Silva	Universidade de Lisboa
Carmen Vela	Spanish Government
Cecilia Donati	Mercator Océan
Christopher Frieling	Fraunhofer Gesellschaft
Cristina Ananasso	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Dan Stanzione	University of Texas at Austin
Delia Doval	Permanent Representation of Spain to the European Union
Dulce Boavida	Directorate-General for Research & Innovation
Eduardo B. de Azevedo	Universidade dos Açores
Eduardo Nunes	Embraer Defense and Security
Elisa Robles	Permanent Representation of Spain to the European Union
Emir Sirage	Fundação para a Ciência e a Tecnologia
Fausto Brito e Abreu	Government of the Azores
Fernando Lobo Pereira	Universidade do Porto
Filipe Castro	Universidade do Porto
Filipe Costa	Universidade do Minho
Frederico Cardigos	European Commission
Geoff McBride	Science and Technology Facilities Council
Griet Storr-Hansen	Permanent Representation of Denmark to the European Union
Gui Menezes	Universidade dos Açores
Hélder Guerreiro Marques da Silva	Universidade dos Açores
Hélène Huby	Airbus Defense and Space
Inmaculada Serrano	Elecnor Deimos
Isabel Sousa Pinto	Universidade do Porto
Isabelle Duvaux-Béchon	European Space Agency
Jaime Silva	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Jan Mikolaj Dzieciolowski	European Commission
Javer Gusejnov	Permanent Representation of Slovak Republic to the European Union
Jean-Jacques Dordain	Ministry for Science, Technology and Higher Education of Portugal
Jean-Michel Monthiller	DG GROU
João Aguiar Machado	Directorate-General for Maritime Affairs and Fisheries
João Antonio Lorenzetti	National Institute for Space Research
João Pedro Taborda	Embraer S.A.
José Fonseca de Moura	Carnegie Mellon University
Juan Sanchez	University of Texas at Austin
Julie Maxton	The Royal Society
Karl Ström	Global Maritime AS
Kristin E. Thorud	The Research Council of Norway
Lauma Sika	Permanent Representation of Latvia to the European Union
Lucia Krajčovicová	Permanent Representation of Slovak Republic to the European Union
Luísa Henriques	Permanent Representation of Portugal to the European Union
Luísa Prista	Directorate-General for Research & Innovation

Luke Incorvaja	Permanent Representation of Malta to the European Union
Manuel Heitor	Minister for Science, Technology and Higher Education of Portugal
Marco Bravo	University of Texas at Austin
Margarida Ribeiro	Directorate-General for Research & Innovation
Maria da Graça Carvalho	Directorate-General for Research & Innovation
Maria João Bebianno	Universidade do Algarve
Marina Cunha	Universidade de Aveiro
Mário Campolargo	Directorate-General for Informatics
Mathias Rauch	Fraunhofer Gesellschaft
Megan Ihrle	US Embassy in Portugal
Miguel Bélló Mora	Elecnor Deimos
Nada Siroti,	Permanent Representation of the Republic of Croatia to the European Union
Ned Dwyer	EuroOcean
Nuno Brito	Permanent Representation of Portugal to the European Union
Nuno Lourenço	Instituto Português do Mar e da Atmosfera
Oriana Grasso	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Patricia Brady	Permanent Representation of Ireland to the European Union
Patrick Heimbach	University of Texas at Austin
Paula Abreu Marques	Directorate-General for Energy
Paula Campos	Directorate-General for Research & Innovation
Paulo Ferrão	Fundação para a Ciência e a Tecnologia
Paulo Guedes	Critical Software
Pedro Miranda	Universidade de Lisboa
Per-Erik Yngwe	Permanent Representation of Sweden to the European Union
Piero Messina	European Space Agency
Rachel Ward	UK Representation to the European Union
Ricardo Serrão Santos	European Parliament
Ronald G. Prinn	Massachusetts Institute of Technology
Roxana Moisii	Permanent Representation of Romania to the European Union
Rui L. Reis	University of Minho
Santiago Rodriguez	Permanent Representation of Spain to the European Union
Sérgio Barbedo	Edison
Sigi Gruber	Directorate-General for Research & Innovation
Stefan Fritz	German Marine Research Consortium
Teresa Ferreira	Universidade dos Açores
Teresa Tavares	Ministry for Science, Technology and Higher Education of Portugal
Tiago H. Silva	Universidade do Minho
Tiago Pardo	Omnidea
Tiago Rebelo	Centro para a Excelência e Inovação na Indústria Automóvel
Tiago Sepúlveda	Edison
Tony Lewis	University College Cork
Vibeke Pasternak Jorgensen	Permanent Representation of Denmark to the EU

Climate Change and Energy, Space and Oceans

WORKSHOP

7

Bogotá

October, 4th - 5th 2016

October 4th, 2016

Manuel Heitor, Minister for Science, Technology and Higher Education was in Bogota, Colombia from the 4th till the 5th of October 2016, promoting the Agenda “Atlantic Interactions” amongst the Colombian research, academic and business community.

On October 4th, Minister Heitor participated at the Meeting “Education for Peace”, organized by Universidad Antonio Nariño, where he presented the subject “Education for Space: Education for Peace”.



LIST OF PARTICIPANTS IN THE WORKSHOP 7

NAME	ORGANIZATION
Carlos Martinez	Universidad Antonio Nariño (UAN)
Gloria Casas	Universidad Antonio Nariño (UAN)
Enrique Caceres	Universidad Antonio Nariño (UAN)
Mauricio Gomez	Universidad Antonio Nariño (UAN)
José R. Cure	Universidad Militar Nueva Granada (UMNG)
Teresa Tavares	Ministerio da Ciencia, Tecnología y Enseñanza Superior
João Ribeiro de Almeida	Universidad Antonio Nariño (UAN)
Jinyola Blanco	Universidad Antonio Nariño (UAN)
Clara Camargo	Universidad Antonio Nariño (UAN)
Fernanda Navas	Universidad Antonio Nariño (UAN)
Pablo Abad	Universidad Antonio Nariño (UAN)
Ligia Rodriguez	Universidad Jorge Tadeo Lozano
Isabel Tafur	Fundación Alpina
Astrid Jaime	Universidad Antonio Nariño (UAN)
Claudia Hoyos	Universidad Antonio Nariño (UAN)
Jorge Cifuentes	Universidad Antonio Nariño (UAN)
Gustavo Mora	Universidad Antonio Nariño (UAN)
Rafael Hurtado	Comisión Colombiana del Océano (CCO)
Carlos H. Forero	Asociacion Colombiana de Universidades (ASCUN)
Mariela Iregui Guerrero	Universidad Militar Nueva Granada (UMNG)
Lucila Escamilla	Universidad Antonio Nariño (UAN)
Fabio Castro	Universidad Antonio Nariño (UAN)
Enrique Forero	Academia Colombiana de Ciencia Exactas
Ivan Montenegro	COLCIENCIAS
Adriana Hidalgo	Universidad Antonio Nariño (UAN)
Eduardo Posada	Centro Internacional de Física (CIF)
María Piedad Villaveces	Asociación Colombiana para el Avance de la Ciencia (ACAC)
Jorge Celis	Secretaría de Educación
Carlos Lopera	Observatorio de la Universidad
Francisco Manrique	CONNECT
Jairo Almanza	Fundación para la Gestión y el Desarrollo de Colombia (Fundagedescol)
Luiz F Ramirez	Universidad de la Salle
Nancy Camacho	Escuela Taller de Boyaca
Mario Cordoba	Universidad Antonio Nariño (UAN)
Constanza Alarcon	Fundación Alpina
Carlos Enrique Arroyave	Universidad Antonio Nariño (UAN)
Lorena Ruiz	Universidad Antonio Nariño (UAN)
Oscar Alberto Duarte	Universidad Antonio Nariño (UAN)

On October 5th 2016

the Minister of Science, Technology and Higher Education, Manuel Heitor addressed the Colombian research and business community at the Maloka Science Museum in the session «Sustainable technological and Collaborative Development of South Atlantic- The future Azores Research Center»



LIST OF PARTICIPANTS IN THE WORKSHOP 7

NAME	ORGANIZATION
Hernando Jimenez	Universidad Antonio Nariño (UAN)
Pablo Abad	Universidad Antonio Nariño (UAN)
Luz Piedad Romero	Universidad de Ciencias Aplicadas y Ambientales (UDCA)
Xiomara Zarur	Universidad de Ciencias Aplicadas y Ambientales (UDCA)
José Cure	Universidad Militar Nueva Granada (UMNG)
David Peña	Departamento Nacional de Planeación (DNP)
Dayana Becerra	Universidad Antonio Nariño (UAN)
Diana Peña	Comisión Colombiana del Océano (CCO)
Alejandro Restrepo	Comisión Colombiana del Océano (CCO)
Jorge Camargo	Universidad Antonio Nariño (UAN)
Nixon Javier Torres	Dirección General Marítima (DIMAR)
Celis Agredo	ASINAL
Galo Tovar	COLCIENCIAS
Yesid Ojeda	COLCIENCIAS
Oscar Alberto Duarte	Universidad Antonio Nariño (UAN)
Lorena Ruiz	Universidad Antonio Nariño (UAN)
Carlos Enrique Arroyave	Universidad Antonio Nariño (UAN)
Astrid Jaime	Universidad Antonio Nariño (UAN)
Claudia Hoyos	Universidad Antonio Nariño (UAN)



Climate Change and Energy, Space and Oceans

WORKSHOP

8

Cartagena das Índias, Colômbia

September, 6th 2016

WORKSHOP 8 • AGENDA

II Reunião Iberoamericana de Ministros e Altas Autoridades de Ciência, Tecnologia e Inovação

9:00-9:20 SESSÃO DE ABERTURA

Rebeca Grynspan Secretaria General
Secretaría General Iberoamericana - SEGIB
Baneth Giha Directora General
Departamento Administrativo de Ciencia, Tecnología e Innovación de Colômbia
Juan Manuel Santos Presidente de la República de Colômbia

9:20 -9:30 APRESENTAÇÃO DOS COMPROMISSOS DA CIMEIRA DE 2014-FÉLIX GARCIA, COORDENADOR ESPAÇO IBEROAMERICANO DO CONHECIMENTO - SEGIB

9:30-10:00 BANCO IBEROAMERICANO DE AVALIADORES. COLHMBIA E MEXICO

10:00-10:30 AGENDA CIDADÃ. MEXICO E COLHMBIA

10:30-11:00 PORTAL DE MOBILIDADE DE INVESTIGADORES IBEROAMERICANOS. COLHMBIA E ESPANHA

11:00-11:30 COFFEE BREAK

11:15-11:30 CONCLUSÕES E ACORDOS DOS COMPROMISSOS DE 2014 Félix García.Coordenador Espaço Iberoamericano do Conhecimento] SEGIB

Ciência Aberta

11:30-12:00 CIENCIA ABERTA E DESENVOLVIMENTO SUSTENTÁVEL- Sarita Albagli [Brasil]IBICT]MCT, Universidade Federal do Rio De Janeiro

12:00-12:25 PROJETO: LEARN @ CEPAL- WOUTER SCHALLIER

12:25-12:50 PROJETO: DIAL-NET, UNIVERSIDADE DA RIOJA

12:50-13:15 LA REFERENCIA-PATRICIA MUNOZ PALMA, PRESIDENTE

13:15-13:30 FOTO OFICIAL

13:30-14:30 ALMOÇO

14:30-15:00 “INTERAÇÕES ATLÂNTICAS: UMA NOVA AGENDA DE Cd T COM EDUCAÇÃO E CULTURA: EDUCAÇÃO PARA O ESPAÇO/ESPAÇO PARA A EDUCAÇÃO”, MANUEL HEITOR, MCTES, PORTUGAL

15:00-15:30 “TRANSFERENCIA DE CONHECIMENTO E USO PARTILHADO DE INFRAESTRUTURAS” Paulo Speller, SG _OEI e Sergio Daniel Matheos, Subsecretário de Coordenação Institucional] MINCBT

15:30-16:30 PAINEL CIENCIA ABERTA

Moderadora
Carmen Vela, Secretária de Estado da Investigação, Tecnologia e Inovação (MINECO), Espanha

Oradores
Enrique Cabrero, DG , CONACBT, México
Jorge Motta, Secretário, SENACBT, Panamá
René Ramírez, Secretário, SENESCCBT, Equador

16:30-16:45 COFFEE-BREAK

16:45-18:00 Acordos e Compromissos

Dia 6 Outubro, Cartagena das Índias

Ministro Manuel Heitor participou no encontro internacional de educação em engenharia subordinado ao tema “Inovação nas faculdades de engenharia: a mudança para a competitividade e a sustentabilidade”. Este evento foi organizado pela ACOFI – Associação Colombiana de Faculdades de Engenharia e contou com a participação de centenas de académicos e profissionais da América Latina. Na sua intervenção o Ministro Manuel Heitor apresentou a Agenda de Investigação ‘Interações Atlânticas’ e o AIR Centre.





Climate Change and Energy, Space and Oceans

WORKSHOP

9

Brasília

October 31st 2016 • Agência Espacial Brasileira

WORKSHOP 9 • AGENDA

9H30 ABERTURA DO ENCONTRO

Manuel Heitor, Ministro da Ciência, Tecnologia e Ensino Superior
Benedicto Fonseca Filho, Embaixador

10H00 APRESENTAÇÃO SOBRE A INICIATIVA AIR CENTER- SITUAÇÃO ATUAL, ASPETOS CIENTÍFICOS E DE PESQUISA, OPORTUNIDADES PARA OS PAÍSES ENVOLVIDOS E MODELO DE GESTÃO DO CENTRO

10H50 APRESENTAÇÕES SOBRE INICIATIVAS BRASILEIRAS DE PESQUISA ESPACIAL E POSSÍVEL RELAÇÃO COM A INICIATIVA DOS AÇORES

- Apresentação da Agência Espacial Brasileira (AEB)
- Apresentação do Instituto Nacional de Pesquisas Espaciais (INPE)

11H40 APRESENTAÇÕES SOBRE INICIATIVAS BRASILEIRAS DE PESQUISA OCEÂNICA E POSSÍVEL RELAÇÃO COM A INICIATIVA DOS AÇORES:

- Apresentação da Coordenação de Mar e Antártida (CMA/MCTIC)
- Apresentação do Serviço Geológico do Brasil (CPRM) em coordenação com a Secretaria da Comissão Interministerial para os Recursos do Mar (SECIRM)
- Apresentação do Instituto de Pesquisa da Marinha (IPQM)

12H30 “BRUNCH” A SER OFERECIDO PELA AEB

14H00 MESAS REDONDAS

Mesa A - Observação oceânica, pesquisa marinha e mar profundo

Mesa B - Observação oceânica, pesquisa espacial e climática

Discussão sobre áreas de pesquisa que sejam de interesse comum

Entender a capacidade científica existente nos Açores e o que se pretende alcançar

Previsão de atividades futuras

Resultados e possíveis desdobramentos para 2017

16H00 APRESENTAÇÃO EM PLENÁRIA DOS PRINCIPAIS RESULTADOS E PLANOS DE TRABALHO



LIST OF PARTICIPANTS IN THE WORKSHOP 9

NAME	ORGANIZATION
Ademir Luiz Xavier Júnior	DSAD/ Agência Espacial Brasileira, BR
Adriana Cursino Thomé	ACI/ Instituto Nacional de Pesquisas Espaciais, BR
Alberto Pedro	Diretor da GMV, PT
Ana Lúcia Stivali	Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
André João Rypł	ACI/ Agência Espacial Brasileira, BR
Andrea Cancela da Cruz Kaled	CMA/ Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Andrei Polejack	CMA/ Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Antônio Ocimar Manz	CPTEC/ Instituto Nacional de Pesquisas Espaciais, BR
Capitão de Fragata Leonardo Martins Barreira	Secretaria de Ciência, Tecnologia e Inovação da Marinha, BR
Capitão de Mar e Guerra Flávio Luiz Giacomazzi	Comissão Interministerial para os Recursos do Mar (SECIRM), BR
Carlos Eduardo Quintanilha Vaz de Oliveira	DTEL/ Agência Espacial Brasileira, BR
Carlos Alberto Gurgel Veras	DSAD, Agência Espacial Brasileira, BR
Carlos Roberto Leite	Comissão Interministerial para os Recursos do Mar (SECIRM), BR
Cleide Passos	CCS/ Agência Espacial Brasileira, BR
Conselheiro Paulo Chiarelli	DMAE/ Ministério das Relações Exteriores, BR
Daniela Miranda	ACI/ Instituto Nacional de Pesquisas Espaciais, BR
Darly Henriques	Centro Gestor e Operacional do Sistema de Proteção da Amazônia (CENSIPAM), BR
Erlon Luisi Cardoso	ASSIM/ Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Jean Batana	DSAD/ Agência Espacial Brasileira, BR
José Iram Mota Barbosa	DPOA/ Agência Espacial Brasileira, BR
Elsa Alexandrino	Business Developer, DEIMOS, PT
Embaixador Benedito Fonseca e Filho	DCT/ Ministério das Relações Exteriores, BR
Fabício Gonzaga Araújo	DCTEC/ Ministério das Relações Exteriores, BR
Ivo Pessanha	CPRM Serviço Geológico do Brasil, BR
João Antônio Lorenzetti	OBT/ Instituto Nacional de Pesquisas Espaciais, BR
José Luiz Ubaldino de Lima	Ministério de Minas e Energia, BR
José Rui Felizardo	CEO, CEIIA, PT
Laudir Schitz	GAEB/ Agência Espacial Brasileira, BR
Lincoln Muniz Alves	CCST/ Instituto Nacional de Pesquisas Espaciais, BR
Luis Henrique da Silva Borda	SCUP, Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Major Brigadeiro do Ar Paulo Roberto Pertusi	, SCUP/ Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Manuel F. L. Soares	LS-Net Consultoria, BR
Maria Virgínea Alves	Instituto Nacional de Pesquisas Espaciais, BR
Manuel Heitor	Ministro da Ciência, Tecnologia e Ensino Superior, PT
Nadia Kornijezku	DPEI/ Agência Espacial Brasileira, BR
Nuno Lourenço	Vice-Presidente, Instituto Português do Mar e Atmosfera, PT
Paulo Ferrão	Presidente, Fundação para a Ciência e Tecnologia, PT
Paulo Monteiro	Paruqe Tecnológico de S. José dos Campos, BR
Ramiro Neves	Centro Meio Ambiente e Tecnologias Marinhas do Instituto Superior Técnico, PT
Raphael Rocha	Ministério da Ciência, Tecnologia, Inovações e Comunicações, BR
Renata Ribeiro	ACI/ Agência Espacial Brasileira, BR
Ricardo Lira	Agência Espacial Brasileira, BR
Ricardo Mendes	Administrador da TEKEVER, PT
Rogério Guedes	Centro Gestor e Operacional do Sistema de Proteção da Amazônia (CENSIPAM), BR
Teresa Tavares	Ministério da Ciência, Tecnologia e Ensino Superior, PT
Yu Chi Au	DPEI/ Agência Espacial Brasileira, BR



Climate Change and Energy, Space and Oceans

WORKSHOP

10

Cambridge, Mass

November 14th 2016

WORKSHOP 10 • AGENDA

Cambridge, Mass

MIT Portugal International Collaboration Meeting

Monday, 14 November 2016

MIT Samberg Center, Building E52, Floor 7, East Room

9:30 INTRODUCTORY REMARKS

Manuel Heitor, Minister of Science, Technology and Higher Education

Paulo Ferrão, President, Fundação para a Ciência e Tecnologia (FCT)

Antonio Cunha, President, Conselho de Reitores das Universidades Portuguesas (CRUP)

SCIENTIFIC PROGRAM ON MIT RESEARCH RELEVANT TO THE AZORES INTERNATIONAL RESEARCH CENTER

9:45 David Miller, Department of Aeronautics and Astronautics, Director, Space System Laboratory

10:15 Alexander Slocum, Department of Mechanical Engineering

10:45 Marija Ilic, Lincoln Laboratory, Energy Systems Group

11:15 Henrik Schmidt, Department of Mechanical Engineering

11:45 Pierre Lermusiaux, Department of Mechanical Engineering

12:15 Colette Heald, Department of Civil and Environmental Engineering, Associate Head

CLOSING REMARKS

Manuel Heitor, Minister of Science, Technology and Higher Education

LIST OF PARTICIPANTS IN THE

WORKSHOP 10

NAME	ORGANIZATION
Carolina Furtado	student
Golnar Hejazi	student
Carlos Gonçalves	student
Miguel Nobrega	Minho
Shenghua Wu	FEUP
Silvia Castro	MPP Coordination office
José Velez Caroço	Consul
Christian Prothmann	MIT
Gonçalo Pereira	MIT
Manuel Heitor	Minister of Science, Technology and Higher Education
Paulo Ferrão	President, Fundação para a Ciência e Tecnologia (FCT)
Antonio Cunha	President, Conselho de Reitores das Universidades Portuguesas (CRUP)
Pedro Arezes	Director of MPP in Portugal
Richard Lester	MIT, Associate Provost for International Activities
Bruce Tidor	MIT, Director of MPP at MIT
Douglas Hart	MIT, Lead of MPP Innovation & Entrepreneurship at MIT (now MIT Co-Director of MPP)
David Miller	MIT, Department of Aeronautics and Astronautics, Director, Space Systems Laboratory
Alexander Slocum	MIT, Department of Mechanical Engineering
Marija Ilic	MIT, Lincoln Laboratory, Energy Systems Group
Henrik Schmidt	MIT, Department of Mechanical Engineering
Pierre Lermusiaux	MIT, Department of Mechanical Engineering
Cole Ke Heald	MIT, Associate Professor and Associate Department Head of Civil and Environmental Engineering
	Associate Professor of Department of Earth, Atmospheric and Planetary Sciences





Climate Change and Energy, Space and Oceans

WORKSHOP

11

Austin, Texas

November 15th - 17th 2016

WORKSHOP 11 • AGENDA

Austin, Texas

November 16th

8:45 AM • Minister Heitor and Dr. Ferrão (MAI 400/President's Office)

9:00 AM • UT Austin faculty -- Space, Energy, Oceans (CBA 6.420 - MSB Conference Room)

10:00 AM • Meet and greet with Dean Jay Hartnell, McCombs School of Business (30 min)

12:00 PM • Minister Heitor and Dr. Ferrão have lunch with Dr. Jaffe (Vice-President for Research)

2:00 PM • Meeting with Dean Mosher (Jackson School of Geosciences, JGB 6.218, Dean's Office Suite)

2:45 PM • Meeting with CIESS Research Staff and affiliated Jackson researchers (Jackson School of Geosciences JGB 6.218 Dean's Conference Room)

Dr. Jay Banner, Department of Geological Sciences

Dr. Dan Breecker, Department of Geological Sciences

Dr. Svetlana Ikonnikova, Bureau of Economic Geology

Dr. Zong-Liang Yang, Department of Geological Sciences/CIESS

Dr. Charles Jackson, UTIG

Mr. Burke Fort, Center for Space Research



LIST OF PARTICIPANTS IN THE
WORKSHOP 11

NAME	ORGANIZATION
Manuel Heitor	Minister of Science, Technology, and Higher Education
Carolina Costa	Chief of Staff, Office of the Minister
Paulo Ferrão	President of the Portuguese Foundation for Science and Technology (FCT)
Fernando Santana	National Director of the UT Austin-Portugal Program

Representatives of the UT Austin-Portugal program areas in Portugal:

Nuno Correia	(Digital Media)
Nuno Silva	(Advanced Computing)
José Urbano	(Applied Mathematics)
Paula Vilarinho	(Nanotechnology)





Climate Change and Energy, Space and Oceans

WORKSHOP

12

Bangalore

January 8th 2017

Presentation of Atlantic Interactions Agenda at ISITE- Satellite Integration and Test Establishment of ISRO – Indian Space Research Organization







Climate Change and Energy, Space and Oceans

WORKSHOP

13

Luanda, Angola

January 30th 31th 2017

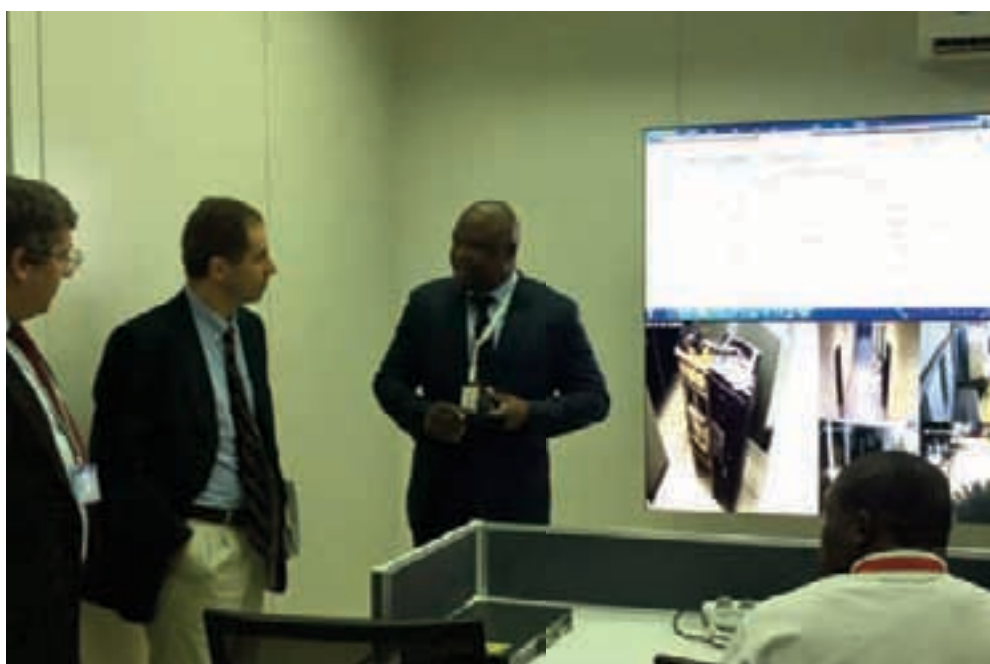
Visit to National Technological Center

Visit to Information Society Institute

Visit to National Research Center

Visit to Polytechnic Institute for Technologies and Sciences

Atlantic Interactions: Discussion of the agenda Atlantic Interactions at Future Forum







LIST OF PARTICIPANTS IN THE WORKSHOP 13

Cândida Teixeira	Minister for Science and Technology, Angola
José Carvalho da Rocha	Minister for Telecommunications and Information Technology, Angola
Sebastião Teta	Deputy Minister for Science and Technology, Angola
Domingos Silva Neto	National Director for Science and Technology, Angola
Domingos do Nascimento	Director of National Institute for Meteorology and Geophysics, Angola
Molapo Ghobela	Executive Director of National Research Foundation, Angola
António Alcochete	National Director of Evaluation and Accreditation of Science and Technology, Angola
Gabriel Luís Miguel	Director of National Technological Centre, Angola
Julius Almeida	Head of Cabinet at Ministry for Science and Technology, Angola
Manuel Heitor	Minister for Science, Technology and Higher Education, Portugal
Paulo Ferrão	President of the Foundation for Science and Technology, Portugal
António Cunha	President of the Portuguese Universities Rector's Council, Portugal
Nuno Mangas	President of Coordinator Council of Polytechnic Institutes, Portugal
João Sobrinho Teixeira	President of Bragança Polytechnic Institute, Portugal
Rosalía Vargas	President of National Agency Ciencia Viva
Susana Catita	Adviser to the Minister for Science, Technology and Higher Education, Portugal



Climate Change and Energy, Space and Oceans

WORKSHOP

14

Lagos, Nigeria

February 1st 2017

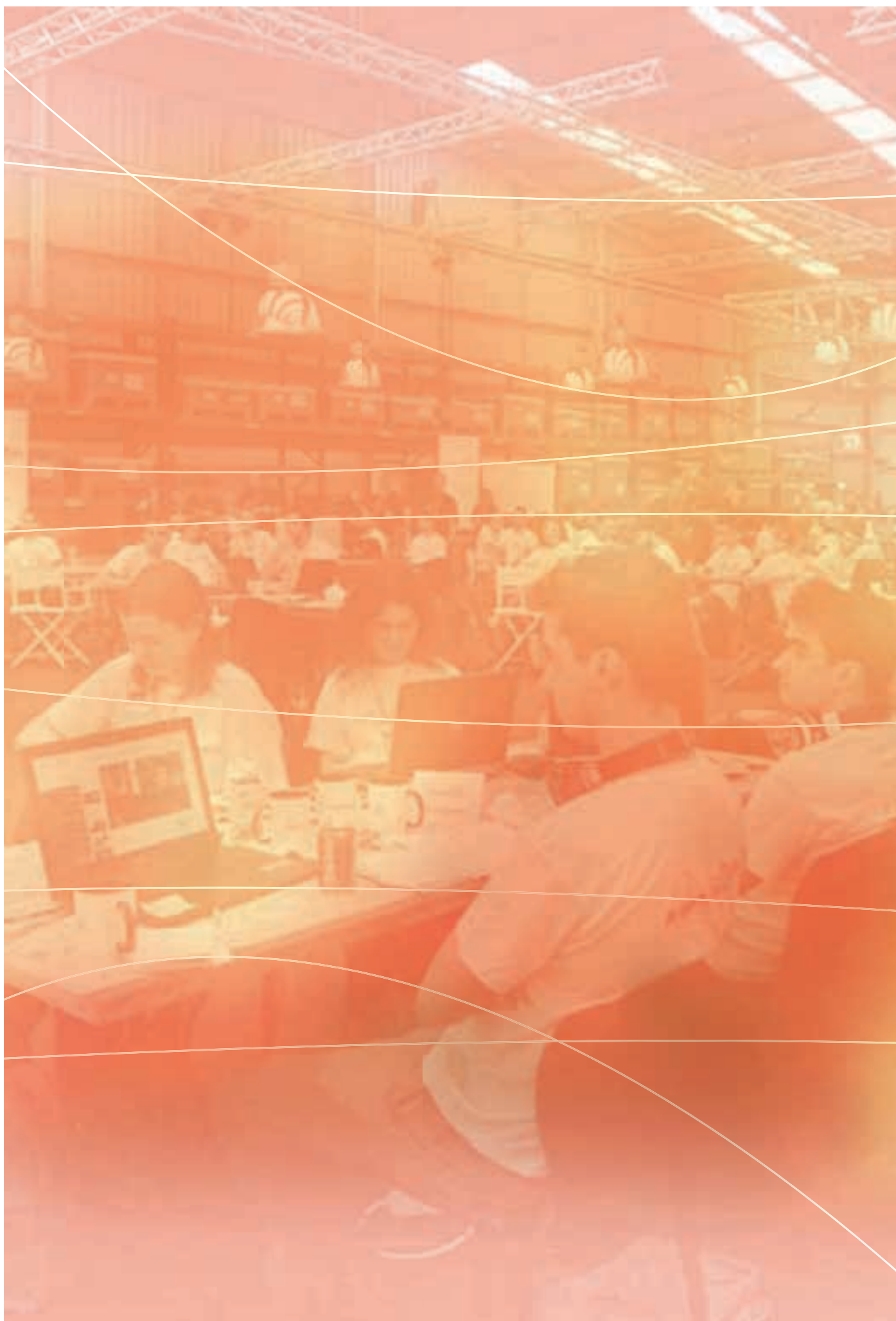
Visit to Nigerian Institute for Oceanography and Marine Research
Visit to Federal Institute of Industrial Research
Visit to Lagos University





LIST OF PARTICIPANTS IN THE WORKSHOP 14

Gloria Elemo	Director General of Federal Institute of Industrial Research Oshodi, Nigeria
Rahamon A Bello	Vice-Chancellor of University of Lagos
Gbola R Akande	Director of Nigerian Institute for Oceanography and Marine Research, Nigeria
Manuel Heitor	Minister for Science, Technology and Higher Education, Portugal
Pedro Rodrigues da Silva	Portuguese Ambassador in Nigeria
António Cunha	President of the Portuguese Universities Rector's Council, Portugal
Nuno Mangas	President of Coordinator Council of Polytechnic Institutes, Portugal
João Sobrinho Teixeira	President of Bragança Polytechnic Institute, Portugal
Rosalia Vargas	President of National Agency Ciencia Viva
Susana Catita	Adviser to the Minister for Science, Technology and Higher Education, Portugal



Climate Change and Energy, Space and Oceans

WORKSHOP

15

Abuja, Nigeria

February 2nd 2017

Visit to National Biotechnology Development Agency
Atlantic Interactions: Discussion of the agenda Atlantic Interactions
at National Space Research & Development Agency - NASRDA



LIST OF PARTICIPANTS IN THE WORKSHOP 15

Ogbonnaya Onu	Federal Minister for Science and Technology, Nigeria
Ibiam Obasy	Special Assistant to the Minister for Science and Technology, Nigeria
Ekanem Udoh	Director of Science and Technology Promotion, Nigeria
Ibrahim Suleiman	Director of Planning and Policy Analysis, Nigeria
Hussaini Doko Ibrahim	Director-General of Raw Materials Research and Development Council, Nigeria
Thomas Sunday	Director-general of Sheda Science and Technology Complex, Nigeria
Eli Jidere Bala	Director-General of Energy Commission of Nigeria
Mohammed Sani Haruna	Vice-Chairman of National Agency for Science and Engineering Infrastructure, Nigeria
Mohammed Jibrin	Director-General of National Board for Technology Incubation, Nigeria
Dan-Azumi Ibrahim	Director-General of National Office for Technology Acquisition and Promotion, Nigeria
Serdu Mohammed	Director of National Space Research and Development Agency, Nigeria
Lucy Ogbadu	Director General of National Biotechnology Development Agency, Nigeria
Manuel Heitor	Minister for Science, Technology and Higher Education, Portugal
Pedro Rodrigues da Silva	Portuguese Ambassador in Nigeria
António Cunha	President of the Portuguese Universities Rector's Council, Portugal
Nuno Mangas	President of Coordinator Council of Polytechnic Institutes, Portugal
João Sobrinho Teixeira	President of Bragança Polytechnic Institute, Portugal
Rosalia Vargas	President of National Agency Ciencia Viva
Susana Catita	Adviser to the Minister for Science, Technology and Higher Education, Portugal





Integrating Space, Climate,
Oceans and Data Sciences through North-South / South-North Cooperation

High-level Industry-Science-Government Dialogue

Towards the Atlantic International Research Center (AIR Center)

1st High level industry-science-government dialogue on Atlantic Interactions

Terceira, Azores

April 20th - 21th 2017

PROGRAM

Overall Program

Thursday, April 20, 2017

14:k0-16:00: C elcome remarks: Setting the stage

16:k0-18:15: Atlantic Interactions: Informal workshops on future research agendas (4 parallel sessions)

- C orkshop 1: Space - Satellites, new space and launchers
- C orkshop 2: Ocean, climate and atmospheric research
- C orkshop k: Data Management and sustainable energy systems
- C orkshop 4: Scientific culture and education for all: space education and ocean literacy

18:20-18:k0: Closing address and Cocktail, at Reception Hall
Johann-Dietrich C ?rner, Director General, European Space Agency

20:00: Azores Gala Dinner, Terceira Golf Club (Dress code: Business Casual)
Key note speaker: Dale Klein, Associate Vice-Chancellor for Research - The University of Texas System

Friday, April 21, 2017

q:15-12:k0: High level Industry-Science-Government Dialogue (Plenary Session)

- Ministerial Roundtable and Industry-Science-Government Dialogue

12:45-14:k0: Lunch

14:k0-16:00: High level Industry-Science-Government Dialogue (Plenary Session)

- Ministerial Roundtable and Industry-Science-Government Dialogue
- Closing Ministerial Roundtable and Dialogue

16:k0-18:k0: Atlantic Interactions: Technical Session on future steps (Plenary Session)

- Presentation by rapporteurs of C orkshops:
- Space - Satellites, new space and launchers
- Ocean, climate and atmospheric research
- Data management and sustainable energy systems
- Scientific culture and education for all: space education and ocean literacy

18:k0-1q:00: Closing Debate (Plenary Session)

1q:00: Conference Closure

DETAILED PRELIMINARY PROGRAM

Thursday, April 20, 2017

14:00-14:30: Registration and Welcome

14:30-16:00: Atlantic Interactions: Welcome Remarks - Setting the stage

- **Welcome Remarks:**

- Manuel Heitor, Minister of Science, Technology and Higher Education, Portugal
- Gui Menezes, Azores Regional Secretary for Sea, Science and Technology, Portugal
- António Vicente, Head of Cabinet of the European Commissioner for Research, Science and Innovation, European Commission
- Slawomir Tokarski, Director of Innovation and Advanced Manufacturing, DG GROUPE, European Commission

- **Brief initial interventions (3 min each):**

- Johann-Dietrich C. F. rner, Director- General, European Space Agency.
"A space based research agenda for the Atlantic"
- Kumar Sivan, Director of the Vikram Sarabhai Space Centre, Indian Space Research Organisation, India
- Ulisses Mello, President, IBM Research Brazil, Brazil.
"Data management to enable multidisciplinary research in the Atlantic"
- Stewart Bernard, Researcher, Council for Scientific and Industrial Research, South Africa
- Dava Newman, Professor, Massachusetts Institute of Technology, United States of America.
"Formulation of an Earth Operating Platform including oceans, land, air and space"
- Bingjie Bu, Director, Shanghai Engineering Centre for Microsatellites, Chinese Academy of Sciences
- Judite Nascimento, Rector, University of Cape Verde, Cape Verde.
- Pedro Silva Dias, Office of the Rector, University of São Paulo, Brazil.
"The relevance of an transatlantic research cooperation"
- Juan Sanchez, Interim Vice President for Research, University of Texas Rio Grande Valley, United States of America.
- Ricardo Serrão Santos, Member, European Parliament.
"The Atlantic as a North-South, South-North platform for research in Oceans, Climate and Atmosphere"
- Paulo Ferrão, Foundation for Science and Technology, Portugal. "Atlantic interactions towards the AIR Center"

16:00-16:30: Coffee Break

16:30-18:15: Workshops - Parallel Sessions, as described in the following pages

18:20-18:30: Closing address and Cocktail, Reception Hall
Johann-Dietrich C. F. rner,
Director General, European Space Agency

20:00: Azores Gala Dinner, Terceira Golf Club
Key note speaker: Dale Klein, The University of Texas System

4 Workshops - Parallel Sessions (16:30-18:30) - detailed program

16:30-18:15: Workshop 1: Space - Satellites, New Space Industries and Launchers

Chair: Luís Santos, Government of the Azores, Portugal

Rapporteurs: Miguel Bélló Mora, Elecnor Deimos, Spain
Slawomir Tokarski, DG GROUPE, European Commission

Brief Initial Presentations (k min each):

- Ricardo Galvão, National Institute for Space Policies, INPE, Brazil
- Alain Bories, OHB, Germany
- S. Rakesh, Chairman, Antrix Corporation, India
- Hélène Huby, Head of New Space Ventures, Airbus Safran Launchers
- Michael Lauster, Fraunhofer Institute for Technological Trend Analysis INT, Germany
- Marius-Eugen Opran, Romanian Space Agency, Romania
- Piero Messina, European Space Agency
- Claire Barcham, Satellite Launch Programme UK Space Agency, United Kingdom
- Nuno i vila, Deimos, Portugal
- S. K. Kanungo, Director, Launch Vehicle Programme Office, Indian Space Research Organisation, India
- João Costa Pinto, President, PROESPA O, Portugal
- Ricardo Mendes, TEKEVER, Portugal
- Bingjie Bu, Shanghai Engineering Centre for Microsatellites, Chinese Academy of Sciences, China
- Amal Khatri, South Africa National Space Agency, South Africa
- Ricardo Conde, Edisoft, Portugal

Debate: All workshops participants

16:30-18:15: Workshop 2: Ocean, climate and atmospheric research

Chair: Jerry Miller, The National Academy of Sciences, United States of America

Rapporteurs: Marco Ceydert, DG Research and Innovation, European Commission
 Pål Sjørgaard, Ministry of Education and Research, Norway

Brief Initial Presentations (k min each):

- John Evans, Marine Institute, Ireland
- Jailson Bittencourt, Secretary for Policies and Programs, Ministry of Science, Technology, Innovation and Communications, Brazil
- Arthur B. Baggeroer, Massachusetts Institute of Technology, United States of America
- Cristina Pedicchio, President, National Institute for Oceanography and Geophysics - OGS, Italy
- Telmo Morato, University of Azores, Portugal
- Ned Dwyer, EurOcean
- Patrick Heimbach, University of Texas at Austin, United States of America
- Magda Chambriard, former President of the Brazilian National Petrol Agency, Brazil
- Prasanna Kumar, National Institute of Oceanography, India
- Rui Caldeira, Madeira Oceanic Observatory, Portugal
- Steward Bernard, Council for Scientific and Industrial Research, South Africa

Debate: All workshop participants

16:30-18:15: Workshop 3: Data Management and sustainable energy systems

Chair: António Raposo de Lima, IBM-Portugal, Portugal

Rapporteur: João Luís Gaspar, University of Azores, Portugal

Brief Initial Presentations (k min each):

- Dan Stanzione, University of Texas at Austin, United States of America
- António Cunha, Council of Rectors of the Portuguese Universities, Portugal
- José Fonseca de Moura, Carnegie Mellon University, United States of America
- Tony Lewis, Centre for Marine and Renewable Energy, University of Cork, Ireland
- Nuno Catarino, Elecnor Deimos, Portugal
- João Afonso, Portuguese Energy Network Company (REN), Portugal
- Alberto de Pedro, GMV, Spain and Portugal
- Raquel Harper, CONNECT Center, Ireland
- Juan Sanchez, , Interim Vice President for Research, University of Texas Rio Grande Valley, United States of America

Debate: All workshop participants

16:30-18:15: Workshop 4: Scientific culture and education for all: space education and ocean literacy

Chair: Rosalia Vargas, Ciência Viva, Portugal

Rapporteur: Ana Noronha, Ciência Viva, Portugal

Key-note address:

- Teresa Lago, Centre for de Astrophysics at the University of Porto and International Astronomical Union Assistant General Secretary, Portugal

Brief Initial Presentations (k min each):

- Otília Reis, Fullbright Commission
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- Bernardo Mata, Portuguese Task Group for the Extension of the Continental Shelf, Portugal
- Teresa Silva, Astronomic Observatory of Santana, Azores, Portugal
- João Paulo Constância, Expolab - Centro Ciência Viva, Azores, Portugal

Debate: All workshop participants









Friday, April 21, 2017

Atlantic Interactions High level Industry-Science-Government Dialogue

q:15-11:15: Ministerial Roundtable and Industry-Science-Government Dialogue: part 1

Chair: Manuel Heitor, Minister for Science, Technology and Higher Education, Portugal

- Welcome remarks:
- Augusto Santos Silva, Minister of Foreign Affairs, Portugal
- Vasco Cordeiro, President, Regional Government of Azores, Portugal

• **Brief introductory presentations (3 min each):**

- Dava Newman, Apollo Professor of Astronautics, Massachusetts Institute of Technology. Former NASA Deputy-Administrator, United States of America
- Jailson Bittencourt, Secretary for Policies and Programs, Ministry of Science, Technology, Innovation and Communications, Brazil
- Juergen Ackermann, General Secretary, Airbus Safran Launchers, France
- S. Rakesh, Chairman, Antrix Corporation, India
- Stewart Bernard, Council for Scientific and Industrial Research, South Africa

- Ministerial Roundtable and Dialogue: informal discussion around the table (interventions of up to k min each)

• **Closing Summary of Part 1**

- Naledi Pandor, Minister for Science and Technology, South Africa

11:15-11:k5: Group Photo and Coffee Break

11:k5-12:45: Ministerial Roundtable and Industry-Science-Government Dialogue: part 2

Chair: Juan María Vázquez Rojas, General Secretary of Science and Innovation, Spain

- Brief introductory presentations (5 min each):
- Jean-Bves Le Gall, President, Centre National d' Etudes Spatiales (CNES), France
- Steven Leslie, Executive Vice Chancellor for Academic Affairs, The University of Texas System, United States of America
- Bingjie Bu, Director, Shanghai Engineering Centre for Microsatellites, Chinese Academy of Sciences
- Amal Khatri, Executive Director of the Space Programme, South Africa National Space Agency, South Africa
- José Fonseca de Moura, Professor, Carnegie Mellon University, United States of America

- Ministerial Roundtable and Dialogue: informal discussion around the table (interventions of up to k min each)

• **Closing Summary of Part 2**

- B. S. Chowdary, Minister of State for Science, Technology and Earth Sciences, India

12:45-14:k0: Lunch

14:k0-16:00: Ministerial Roundtable and Industry-Science-Government Dialogue: Part k

Chair: Ogbonnaya Onu, Minister of Science and Technology, Nigeria

- Brief introductory presentations (5 min each):
- Kumar Sivan, Director, Vikram Sarabhai Space Centre, Indian Space Research Organisation, India
- Cristina Pedicchio, President, National Institute for Oceanography and Geophysics, Italy
- António Pascoal, Professor, Instituto Superior Técnico, University of Lisbon, Portugal
- Renato Krpoun, Head, Swiss Space Office, Switzerland

- Ministerial Roundtable and Dialogue: informal discussion around the table (interventions of up to k min each)
- Closing Summary of Part k (k min each)

- Maritza Rosabal Peña, Minister for Education, Family and Social Affairs, Cape Verde
- Otilia Reis, Executive Director, Fulbright Commission
- Slawomir Tokarski, Director of Innovation and Advanced Manufacturing, DG GROC , European Commission

- Closing Ministerial Roundtable (interventions of up to k min each)
 - Ivan Dimov, Deputy Minister of Education and Science, Bulgaria
 - Mary Teuw Niane, Minister of Higher Education and Research, Senegal
 - Maria Julia Muñoz, Minister for Education and Culture, Uruguay
 - Olinto Daio, Minister for Education, Culture, Science and Communication, Sao Tome and Principe
 - José Carvalho da Rocha, Minister of Telecommunications and Information Technologies, Angola
 - António Vicente, Head of Cabinet of the European Commissioner for Research, Science and Innovation, European Commission
 - Manuel Heitor, Minister of Science, Technology and Higher Education, Portugal

16:00-16:k0: Coffee Break

16:k0-18:45: Atlantic Interactions: Towards a research agenda for the Atlantic - future steps
Presentations by workshops chairs and rapporteurs

Chair: Manuel Heitor, Minister for Science, Technology and Higher Education, Portugal

Theme 1: Space - Satellites, New space industries and launchers (k min each):

- Luís Santos, Government of the Azores, Portugal
- Miguel Bélló Mora, Elecnor Deimos, Spain
- Slawomir Tokarski, DG GROC , European Commission

Theme 2: Ocean, climate and atmospheric research (k min each):

- Jerry Miller, the National Academy of Sciences, United States of America
- Pål Sørgaard, Ministry of Education and Research, Norway
- Marco Ceydert, DG R&I, European Commission

Theme 3: Data Management and Sustainable Energy Systems (k min each):

- António Raposo de Lima, IBM-Portugal, Portugal
- João Luís Gaspar, University of Azores, Portugal

Theme 4: Scientific culture and education for all: space education and ocean literacy (k min each)

- Rosalia Vargas, Ciência Viva, Portugal
- Ana Noronha, Ciência Viva, Portugal

- Ministerial Roundtable and Dialogue: informal discussion around the table (Interventions of up to k min each)
- Approval of Conclusions

18:45: Conference Closure

Paulo Ferrão, President, Portuguese Foundation for Science and Technology, Portugal

Manuel Heitor, Minister for Science, Technology and Higher Education, Portugal









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CONCLUSIONS

The High Level Industry-Science-Government Dialogue on 'Atlantic Interactions', held in Terceira island on the 20-21 April 2017, was aimed to address the need to further study and conduct research in Atlantic regions in terms of related natural resources, ecosystems dynamics and the interdependences with human activities towards achieving the 2030 United Nations goals for sustainable development, together with the potential exploration of new avenues for knowledge-based economies in south and north Atlantic.

The participants acknowledge the achievements on Atlantic related research over the last five years with the signature of the Galway Statement on Atlantic Ocean Cooperation on 26 May 2016 between the European Union, the United States and Canada, which enabled the alignment of ocean observation efforts, as well as the priorities and actions outlined in the Atlantic Ocean Research Alliance. In addition, the participants have also noted that the results of the series of workshops on 'Atlantic Interactions' held throughout 2016 in New York, Ponta Delgada, Lisbon, Brussels, Paris, Brasília, Cartagena, Bogotá, Cambridge (Mass) and Austin (Texas), as well as other related meetings in Bangalore (India), Luanda (Angola) and Abuja (Nigeria) have mobilized researchers worldwide towards the development of a new science and technology agenda for an integrative approach to the Atlantic focused on space and ocean sciences, as well as the implications of climate change and the development of sustainable energy systems. Participants also note the progress achieved by Southern nations in discussing and establishing a scientific agenda for the Tropical and South Atlantic and the Southern Ocean.

The imperative of building knowledge-based societies demands an investment in our collective institutions to enable them to provide worldwide access to quality science education and scientific practices to everyone, regardless of age, origin or social and economic background. People at large will need to access knowledge and modern learning practices at all ages to build future generations who are becoming increasingly knowledgeable, creative and able to adapt responsibly to the challenges of a rapidly changing world. The future of different people on earth are woven in a single garment. We all gain from the joy and benefits of discovery when all people participate in learning and the productive use of knowledge. This means reaching out and engaging our colleagues, scientists and lay people with young people in all parts of the world.

Each generation should be able to explore new things and have the opportunities to do so.

Participants have agreed that a better understanding of Atlantic regions in terms of their response to climate change and for the sustainable management of common resources entails the alignment of research and economic strategies through north/south - south/north international cooperation.

In addition, Participants recognize:

- The relevance of an integrative approach to space, climate change and energy, earth and ocean sciences in the Atlantic, together with emerging methods of data science, data visualization and science communication to better understand the emerging issues associated to climate change and the sustainable management of common resources affecting our planet and the lives, prosperity and wellbeing of our citizens.
- The need to foster and further develop a shared and international environment to support North-South/South-North cooperation in science and technology towards new climate, earth systems, space, and marine research activities benefiting decision makers, public users, higher education and industry, as well as to foster highly skilled human resources, the exchange of research infrastructures and technology transfer and contribute to growth.
- The urgent need to develop advanced data and network systems including integrated instruments for space, air, ground and ocean domains, allowing sustained data gathering to produce better and more precise models which can supply all scientific disciplines involved in accurately projecting the future sustainable pathways. This requires a sustained and globally distributed ocean-observing system, especially at depths where very few observations currently exist, as well as detailed measurements of atmospheric circulation changes, along with the determination of the Earth's key ecosystems activities and the development of technology to fit science needs. These challenges will require stronger linkages with the educational system to develop curricula for critical and needed skills on data management, artificial intelligence and analytics linked with advanced computing technologies, based on cognitive, high performance computing and cloud platforms which can be secure and scalable.
- The relevance of space science and technology in Atlantic regions to address great challenges such as climate change, natural hazards, energy dependency and sustainable ocean exploitation, considering that satellite data processing opens opportunities for new ventures with economic, environmental and social impact, in areas such as fisheries and aquaculture, maritime safety, managing of marine resources, as well as characterizing the renewable energy potential in islands and coastal environments.
- The urgent need to foster knowledge as our common future, and to recognize the need to bring to the center of our attention all of those in the "margins" of knowledge driven societies and knowledge-based economic activities by increasing social and gender equality, fostering inclusion for everyone, everywhere, anytime, recognizing the need to effectively promote responsible science and innovation for all.

- The opportunity Azores offer for the potential development of international launch services to space, providing low-cost, frequent and regular access to space for small satellites as a way to boost the utilization of space for the benefit of all citizens of planet Earth. The islands of Azores have been identified as a promising launching site thanks to feasibility studies recently performed. These preliminary technical studies have shown that an Azorean spaceport would offer a wide range of Azimuth and good metrological conditions, which may enable regular, and frequent launches. It would benefit from and leverage the current Azorean space infrastructures. Further studies are necessary to guarantee adequate safety, environmental protection, geological stability conditions or electrical and water capacity.

- The critical role of Atlantic islands as ecosystems suitable for holistic research studies through experiments and observation of natural processes. They represent natural living laboratories enabling and facilitating the design of scientific studies of international relevance. Island research stations are ideal for designing and achieving direct and precise observations especially required for studying biophysical phenomena, but also for validating concepts, techniques, and methodologies, particularly in remote places and/or in circumstances where reliable platforms are scarce.

It is under this context that the participants of High Level Industry-Science-Government Dialogue on 'Atlantic Interactions' have identified the following major steps to be pursued:

1. The need to align research strategies through international cooperation to face Atlantic regions challenges and economic transitions towards the sustainable development of our societies. Environmental changes, security conditions, natural hazards, and other human dimensions, calls for the design of an international partnership that aims for resilience and sustainability for the Atlantic and related North-South / South-North cooperation in the following five thematic areas: Space systems and applications, Atmospheric science, Climate change and energy systems, Ocean systems, and Data sciences.

2. Greet the efforts developed in setting a bottom up strategic research agenda through an integrative approach to Space, Climate-Energy, Oceans and Data Sciences in the Atlantic, to support North-South/South-North cooperation in science and technology, ultimately benefiting decision makers, public users, universities and industry, as well as fostering highly skilled human resources, the exchange of research infrastructures and technology transfer and contribute to the sustainable growth of our countries and regions.

3. Support the idea of the need to guarantee an increasing effort and global initiative on "Knowledge for Space - Space for knowledge" aiming to promote scientific education and culture about emerging space systems and technologies, as well as to better use space technology to promote scientific and education contents for all, in every region of the planet. The Atlantic regions could be used as a platform to foster a pilot project in this direction.

4. Welcome the advances made to the draft version of the Chite Paper "Towards a Science and Technology Agenda for an integrative research approach in Atlantic regions through North-South Cooperation" and propose this strategic research agenda to be finalized and implemented through an international network of research, academic and business organizations worldwide, across both south and north Atlantic countries, as well as non-Atlantic countries, in an international scientific organization, bringing together infrastructures located throughout the Atlantic: the Atlantic International Research Center (AIR Center), as an initiative to be established in the form of an inclusive international research network organization with headquarters in the Azores Islands.

5. Note that the AIR Center will consider the development of a new interdisciplinary research platform and initiative, extending the capabilities of research centers around the world and addressing the synergies between Space, Climate-Energy, Oceans and Data Sciences, and this would enhance the potential of the existing Atlantic research infrastructures since it would focus on disciplines that combine more than one scientific area, acting as a catalyst for research and innovation in multiple domains ranging from renewable energies, to the interactions of the ocean with the atmosphere and global climate phenomena, the impacts of global changes on the open ocean and the deep sea, including their biodiversity, as well as blue economy.

6. Recognize that the AIR Centre should consider stimulating the necessary knowledge-driven conditions to better use the strategic positioning of Atlantic islands by establishing a network of 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, thus increasing operational efficiencies by optimizing the appropriate use and sharing of research infrastructures, and access to and management of data and platforms.

7. Propose that the creation of the AIR Center should be attempted in the form of an international venture and an intergovernmental organization to accomplish the following goals:

- Promoting a new holistic and integrative approach to knowledge on space, climate-energy, oceans and data sciences and related issues in the Atlantic, fostering conditions to provide the world with more science, more knowledge and more scientific culture
- Fostering an inclusive approach to science, technology and economic development, bringing to the center of our attention all of those in the "margins" of knowledge driven societies and knowledge-based economic activities.

- Establishing a network of research sites in various Atlantic islands in north and south Atlantic, in close interaction with research, academic and business organizations worldwide, including those across both south and north Atlantic countries, as well as non-Atlantic countriesR
- Facilitating the access to space data from the unique position of the Azores, promoting access to new frontiers of knowledge, together with the development of new space industriesR
- Stimulating the test of new renewable energy sources and their integration in smart networks in islands environments, promoting test beds for the development of new sustainable energy industriesR
- Promoting new research in deep-sea, facilitating the access to a better understanding of living organisms in extreme environments and new energy and mineral sourcesR
- Fostering the study of earth processes in the Atlantic triple junction, where three major tectonic plates met, to contribute for the understanding and risk mitigation of the derived natural hazards, namely earthquakes, volcanism, tsunamis.
- Facilitating the establishment and use of new mega-sets of data on climate, atmospheric, earth, ocean and energy related themes stimulating new forms of data science and the development of new technology-based companies oriented towards big data processing and usage.
- Promoting and fostering the education and knowledge agenda “knowledge for space/ Space for knowledge” and its integration with ocean, earth and climate education in a holistic way, fostering the interest and mobilization of younger generations for science and technology, as well as contributing for educating more children everywhere, anytime.

8. C elcome IR’s Center openness to the world by establishing different forms of scientific and technological collaboration with public and private entities from non-Atlantic countries across the globe, thus providing a truly international shared environment, which will promote amongst others, the development of comparative studies and projects on other seas, oceans, such as the Indian, Artic, and Pacific Oceans and the Mediterranean.

9. Recognize the support jointly offered by the Fulbright Commission Portugal and the Portuguese Science and Technology Foundation to launch a fFulbright Award on Atlantic International Researchf to be promoted until the end of 2017 in close collaboration with the establishment of the AIR Center.

Consequently, the participants of High Level Industry-Science-Government Dialogue on ‘Atlantic Interactions’ invite:

- All participants of the High Level Industry-Science-Government Dialogue on ‘ tlanctic Interactions’, to deepen the dialogue to advance new research on the Atlantic and promote new models for North-South/South-North partnership-based approach which can contribute to the sustainable management of all our societies.
- The Portuguese Government and the Regional Government of Azores, together with the Portuguese Foundation for Science and Technology, FCT, to promote an open international process and competition to attract business leaders and entrepreneurs worldwide to further discuss the development of international launch services to space from the Azores, providing low-cost, frequent and regular access to space for small satellites as a way to boost the utilization of space for the benefit of all citizens of planet Earth.
- The Portuguese Foundation for Science and Technology, FCT, to establish a small, high level, expert committee to guarantee the conclusion of the C hite Paper “Towards a Science and Technology Agenda for an integrative research approach in Atlantic regions through North-South Cooperation” before the end of September 2017, including the following members:
 1. Juan Maria Vazques Rojas, General secretary of Science and Innovation, Spain
 2. Jailson Bittencourt, Secretary for Policies and Programs, Brazil
 - k. Patrick Heimback, University of Texas at Austin, USA
 4. Stewart Bernard, Council of Scientific and Industrial Research, South Africa
 5. Paulo Ferrão, President, Portuguese Foundation for Science and Technology (Chair)
- The Portuguese Government and the Regional Government of Azores, together with the Portuguese Foundation for Science and Technology, FCT, to facilitate the efforts to set up a high level working group composed by representatives of Governments, industry, research and academic organizations interested in moving forward the establishment of the AIR Center. The members of the working group will meet in Lisbon by July 2017 and prepare a joint implementation and financial plan towards the establishment of the AIR Center, by the end of 2017. The working group will include the following members (Others to be confirmed):

- Juan Maria Vazques Rojas, General secretary of Science and Innovation, Spain
 - Jailson Bittencourt, Secretary for Policies and Programs, Brazil
 - Juan Sanchez, University of Texas Rio Grande Valley, USA
 - Stewart Bernard, Council of Scientific and Industrial Research, South Africa
 - United Kingdom (expert to be confirmed)
 - Tony Lewis, Center for Marine and Renewable Energy, University College Cork, Ireland
 - Federal Ministry of Science and Technology, Nigeria (expert to be confirmed)
 - European Space Agency (expert to be confirmed)
 - Cape Verde (expert to be confirmed)
 - S. Rakesh, Chairman, ANTRIX, India
 - Argentina (expert to be confirmed)
 - António Alberto Alcochete, Director, National Directorate for the Evaluation and Accreditation of Science and Technology, Angola
 - Italy (expert to be confirmed)
 - Carlos Enrique Arroyave Posada, Vice Rector, University of Antonio Nari
 - Bulgaria (expert to be confirmed)
 - David González, Director of Science and Technology, Uruguay
 - Regional Secretariat for Sea, Science and Technology (expert to be confirmed)
 - Paulo Ferrão, President, Portuguese Foundation for Science and Technology (Chair)
- All stakeholders involved in the establishing the AIR Center should attempt to finalize the ratification of the AIR Center legal instrument by the beginning of 2018 and to complete the initial installation by the end of 2018. To guarantee achieving this objective, a meeting will be organized in the end of November 2017 in Brazil (date and venue to be informed until July 2017).

















Further Specialized
Research workshops
and working meetings



Further Specialized Research workshops and working meetings

WORKSHOP

1

German Research Centre for Geosciences
(GFZ), Potsdam

May 22nd 2017

**ROUND TABLE AND WORKSHOP:
GERMAN-PORTUGUESE COOPERATION IN THE FIELD OF RESEARCH**

Date: 22 May 2017

Place: German Research Centre for Geosciences (GFZ), Potsdam

WORKSHOP 1 • AGENDA**10:45 AM – 11:00 AM: ARRIVAL**

Welcome address by Dr. Uwe Schneider, Staff Scientific Executive Board, GFZ

11:00 AM – 11:35 AM: OPENING / INTRODUCTIONS

1. Openings: State Secretary Schütte and Minister Heitor
2. Introductory notes
 - Cooperation in the field of marine research: GEOMAR
 - Atlantic International Research Center: MCTES
 - Applied research cooperation in practice: Fraunhofer Portugal
 - Experiences with and funding of research and mobility: FCT

11:35 AM – 12:30 PM: ROUND TABLE

1. Opening round: reactions to the introductory notes
2. Political frame: European and bilateral instruments of cooperation
3. Focus topics: marine research, bioeconomy, high-performance computing
4. Cooperation and Mobility: experiences and perspectives

12:30 PM – 2:00 PM: LUNCH BREAK: CAFÉ FREUNDLICH, TELEGRAFENBERG, POTSDAM**2:00 PM – 2:45 PM: WORKSHOP AND VISITS (PARALLEL)**

1. Visits of research institutions at Telegrafenberg: GFZ and AWI
2. Workshop on Marine Research: exchange between the experts from the field

2:45 PM – 3:00 PM: CLOSING SESSION

1. Address by Prof. Hüttl, Chairman of the Board, Scient. Exec. Director GFZ
2. Report from the Workshop
3. Closure: Minister Heitor und State Secretary Schütte

LIST OF PARTICIPANTS IN THE WORKSHOP 1

GERMANY

NAME	ORGANIZATION
Georg Schütte	State Secretary to the Federal Minister of Education and Research
Reinhard Hüttl	Chairman of the Board and Scientific Executive Director, German Research Center for Geosciences (GFZ)
Uwe Schneider	Staff Scientific Executive Board, German Research Center for Geosciences (GFZ)
Martin Visbeck)	Geomar, Deputy Chair German Marine Research Consortium (DKM)
Bernhard Diekmann	Alfred Wegener Institute (AWI), Head of Potsdam Research Unit
Matthias Haeckel	Geomar, JPI Oceans
Pedro Almeida	Head of Fraunhofer Portugal
Torsten Nyncke	Fraunhofer Society (FhG), International Relations
Cora Laforet	German Research Foundation (DFG), Director for International Cooperation
Miguel Haubrich Seco	Leibniz Association (WGL), International Relations
Matthias Premke-Kraus	Leibniz Association (WGL), Environmental Research
Harald R. Haakh	Federal Ministry of Education and Research, European Cooperation
Tim Eder	Federal Ministry of Education and Research, Marine Research
Judith Schicks	Researcher, German Research Center for Geosciences (GFZ)
Thilo Schöne	Researcher, German Research Center for Geosciences (GFZ)
Jörn Lauterjung	Researcher, German Research Center for Geosciences (GFZ)
Ingo Bräuer	Potsdam Institute of Climate Impact Research (PIK)

PORTUGAL

NAME	ORGANIZATION
Manuel Heitor	Minister for Science, Technology and Higher Education
João Mira Gomes	Ambassador of Portugal
António Cunha	President of the Portuguese Council of Rectors
Paulo Ferrão	President of the Foundation for Science and Technology (FCT)
Filipe Porteiro	Regional Director for the Sea
Miguel Miranda	President, Portuguese Institute for the Sea and Atmosphere (IPMA)
Nuno Lourenço	Vice President, Portuguese Institute for the Sea and Atmosphere (IPMA)
Ana Freitas	Reitor, University of Évora
Arlindo Oliveira	President, Instituto Superior Técnico
Ana Quartin	Director, International Relations Officer, (FCT)
Teresa Tavares	Adviser, Ministry for Science Technology and Higher Education
Rita Guerra	Counsellor, Portuguese Embassy in Berlin
Rui Manuel da Silva Fernandes	Professor, Space and Earth Geodetic Analysis Laboratory (SEGAL), University of Beira Interior
Eduardo Azevedo	Professor, University of the Azores
Marina Cunha	Professor, CESAME- Center for Environmental and Marine Studies, Universidade de Aveiro.
Tiago Filipe Baptista da Rosa Repolho	Marine and Environmental Sciences Center- MARE/ Universidade de Lisboa
Pedro Afonso	IMAR/DOP University of Azores

ATLANTIC INTERACTIONS The 1st year of a process of scientific diplomacy

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Further Specialized Research workshops and working meetings

WORKSHOP

2

Canary Island

June 20th 2017

WORKSHOP 2 • AGENDA

10:00: WELCOME AND PRESENTATION OF THE OBJECTIVES OF THE MEETING

Delegada del Gobierno en la Comunidad Autónoma de Canarias – Mercedes Roldós Caballero
Secretario General de Ciencia e Innovación – Juan María Vázquez
Presidente de la Fundação para a Ciência e a Tecnologia (FCT) – Paulo Ferrão
Director de la Agencia Canaria de Investigación,
Innovación y Sociedad de la Información – Manuel Miranda

10:30: PRESENTATION OF THE WHITE PAPER ON AIR CENTER

FCT, Sofia Cordeiro

10:45: RESEARCH INFRASTRUCTURES IN AZORES AND THE AIR CENTER

Secretario Regional do Mar, Ciência e Tecnologia - Gui Menezes

11:00: ASTRONOMY

ES: Subdirector del Instituto Astrofísica de Canarias (IAC) – Carlos Martínez Roger.
PT: Instituto de Astrofísica e Ciências do Espaço - João Lima

11:30: COFFEE BREAK

12:00: SPACE

ES: Director de Programas Internacionales del Centro para el Desarrollo Tecnológico Industrial (CDTI) - Juan Carlos Cortés.

12:30: THE ATLANTIC OCEAN AND CLIMATE CHANGE

ES: Vicepresidenta Adjunta de Áreas Científico-técnicas del Consejo Superior de Investigaciones Científicas (CSIC)- Victoria Moreno-Arribas.

12:45H: OCEANOGRAPHIC OBSERVATORIES IN THE ATLANTIC OCEAN

ES: Director de la Plataforma Oceánica de Canarias (PLOCAN) - Octavio Llinas.
PT: Universidade dos Açores - Ana Martins

13:00: LUNCH

14:15H: FLOTA BUQUES DE INVESTIGACIÓN OCEANOGRÁFICA:

ES: Director del Instituto Español de Oceanografía (IEO) - Eduardo Balguerías.
PT: Instituto Português do Mar e Atmosfera (IPMA) - António Miguel Santos

14:45H: UNIVERSITIES AND BLUE GROWTH

ES: Conferencia de Rectores de Universidades Españolas (CRUE):
Rector de la Universidad de Las Palmas de Gran Canarias, D. Rafael Robaina.
Director Científico del Campus de Excelencia Internacional del Mar (CEIMAR) de la Universidad de Cádiz, D. Fidel Echevarría Navas.

15:00: BIG DATA AND HPC

ES: Director Adjunto del Centro Nacional de Supercomputación (BSC). Josep Martorell
 PT: Presidente del Instituto Superior Técnico - Arlindo Oliveira
 PT: Universidade do Minho - Rui Oliveira

15:30: MARINE ENERGY

ES: Director de División de Energías Renovables del Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) - Enrique Soria
 PT: WAVEC Offshore Renewables - Ana Brito Melo
 PT: Centro de Ciência e Tecnologia do Ambiente e do Mar (MARETEC)
 - Instituto Superior Técnico - Francisco Campuzano

16:00: SUMMARY AND CONCLUSIONS:

ES: Secretario General de Ciencia e Innovación de MINECO - Juan María Vázquez.
 PT: Presidente de la Fundação para a Ciência e a Tecnologia - Paulo Ferrão

LIST OF PARTICIPANTS IN THE WORKSHOP 2

NAME	ORGANIZATION
Mercedes Roldós Caballero	Delegada del Gobierno en la Comunidad Autónoma de Canarias
Juan María Vázquez	Secretario General de Ciencia e Innovación de MINECO
Paulo Ferrão	Presidente de la Fundação para a Ciência e a Tecnologia (FCT)
Manuel Miranda	Director de la Agencia Canaria de Investigación, Innovación y Sociedad de la Información
Sofia Cordeiro	Fundação para a Ciência e a Tecnologia (FCT)
Gui Menezes	Açores, Secretario Regional do Mar, Ciência e Tecnologia
Carlos Martínez Roger	Subdirector del Instituto Astrofísica de Canarias (IAC)
João Lima	Instituto de Astrofísica e Ciências do Espaço
Juan Carlos Cortés	Director de Programas Internacionales del Centro para el Desarrollo Tecnológico Industrial (CDTI)
Victoria Moreno-Arribas	Vicepresidenta Adjunta de Áreas Científico-técnicas del Consejo Superior de Investigaciones Científicas (CSIC)
Octavio Llinas	Director de la Plataforma Oceánica de Canarias (PLOCAN)
Ana Martins	Universidade dos Açores
Eduardo Balguerías	Director del Instituto Español de Oceanografía (IEO)
António Miguel Santos	Instituto Português do Mar e Atmosfera (IPMA)
D. Rafael Robaina	Rector de la Universidad de Las Palmas de Gran Canarias
D. Fidel Echevarría Navas	Director Científico del Campus de Excelencia Internacional del Mar (CEIMAR) de la Universidad de Cádiz
Josep Martorel	Director Adjunto del Centro Nacional de Supercomputación (BSC)
Arlindo Oliveira	Presidente del Instituto Superior Técnico
Rui Oliveira	Universidade do Minho
Enrique Soria	Director de División de Energías Renovables del Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
Ana Brito Melo	WAVEC Offshore Renewables
Francisco Campuzano	Centro de Ciência e Tecnologia do Ambiente e do Mar (MARETEC)- Instituto Superior Técnico







Further Specialized Research workshops and working meetings

WORKSHOP

3

MCTES, Laranjeiras, Lisboa

July 14th 2017

WORKSHOP 3 • AGENDA

MEETING OF THE HIGH LEVEL WORKING GROUP

Venue: Office of the Minister for Science, Technology and Higher Education,
MCTES, Palácio das Laranjeiras, Estrada das Laranjeiras, 205, Lisboa

9H-9H30 WELCOME REMARKS

Manuel Heitor, Minister for Science, Tech. and Higher Educ., Portugal
Gilberto Kassab, Minister for Science, Technology, Innovation and Telecommunications, Brazil

9H30-10H FOLLOW UP FROM THE HIGH LEVEL MEETING IN TERCEIRA, AZORES (20-21 APRIL):

1. Preparation of the White Paper on “Atlantic Interactions” (annex 2)
2. Preparation of the installation of the AIR Center

Chair:

Paulo Ferrão, President of Portuguese Science and Technology Foundation (FCT), Portugal

10H-11H TOPIC 1: AIR CENTER - TOR : INSTITUTIONAL, GOVERNANCE AND FUNDING

Presentation of Draft Proposal for ToR (annex 3) and Tour de table discussion

Chair:

Paulo Ferrão, President of FCT, Portugal

11H-11H30 BREAK

11H30-13H TOPIC 2: AIR CENTER - TOR : INSTITUTIONAL, GOVERNANCE AND FUNDING

Comparative analysis and discussion of existing intergovernmental organisations: European Southern Observatory (ESO); International Nanotechnology Institute (INL); European Organization for Nuclear Research (CERN); others.

Presentation and Tour de Table discussion

Chair:

Paulo Ferrão, President of FCT, Portugal

13H-14H LUNCH

14H-15H30 TOPIC 3: AIR CENTER – MOU AMONG POTENTIAL FOUNDING MEMBERS, ASSOCIATE MEMBERS AND OTHERS:

Presentation of Draft Proposal for MoU (annex 4) and Tour de table discussion

Chair:

Paulo Ferrão, President of FCT, Portugal

15H30-16H TOPIC 4: PREPARATION OF THE HIGH LEVEL MEETING IN BRAZIL, FLORIANOPOLIS, NOVEMBER 2017

Chair:

Jailson Bittencourt, Secretary for Policies and Programs, Brazil

16H-16H30 NEXT STEPS AND CLOSING REMARKS

Manuel Heitor, Minister for Science, Technology and Higher Education, Portugal
Naledi Pandor, Minister for Science and Technology, South Africa

ANNEXES:

1. List of participants: Invitations and expected confirmations
2. Current revised version of the White Paper on "Atlantic Interactions", July 2017; working document;
3. Initial draft proposal for the AIR Center Terms of Reference (ToR); working document;
4. Initial draft proposal for the AIR Center MoU among potential Founding Members, Associate Members and other; working document;

LIST OF PARTICIPANTS IN THE WORKSHOP 3

OPENING AND CLOSING REMARKS:

NAME ORGANIZATION

Manuel Heitor	Minister for Science, Technology and Higher Education, Portugal
Naledi Pandor	Minister for Science and Technology, South Africa
Gilberto Kassab	Minister for Science, Technology, Innovations and Communications, Brazil

TECHNICAL MEETING:

NAME ORGANIZATION

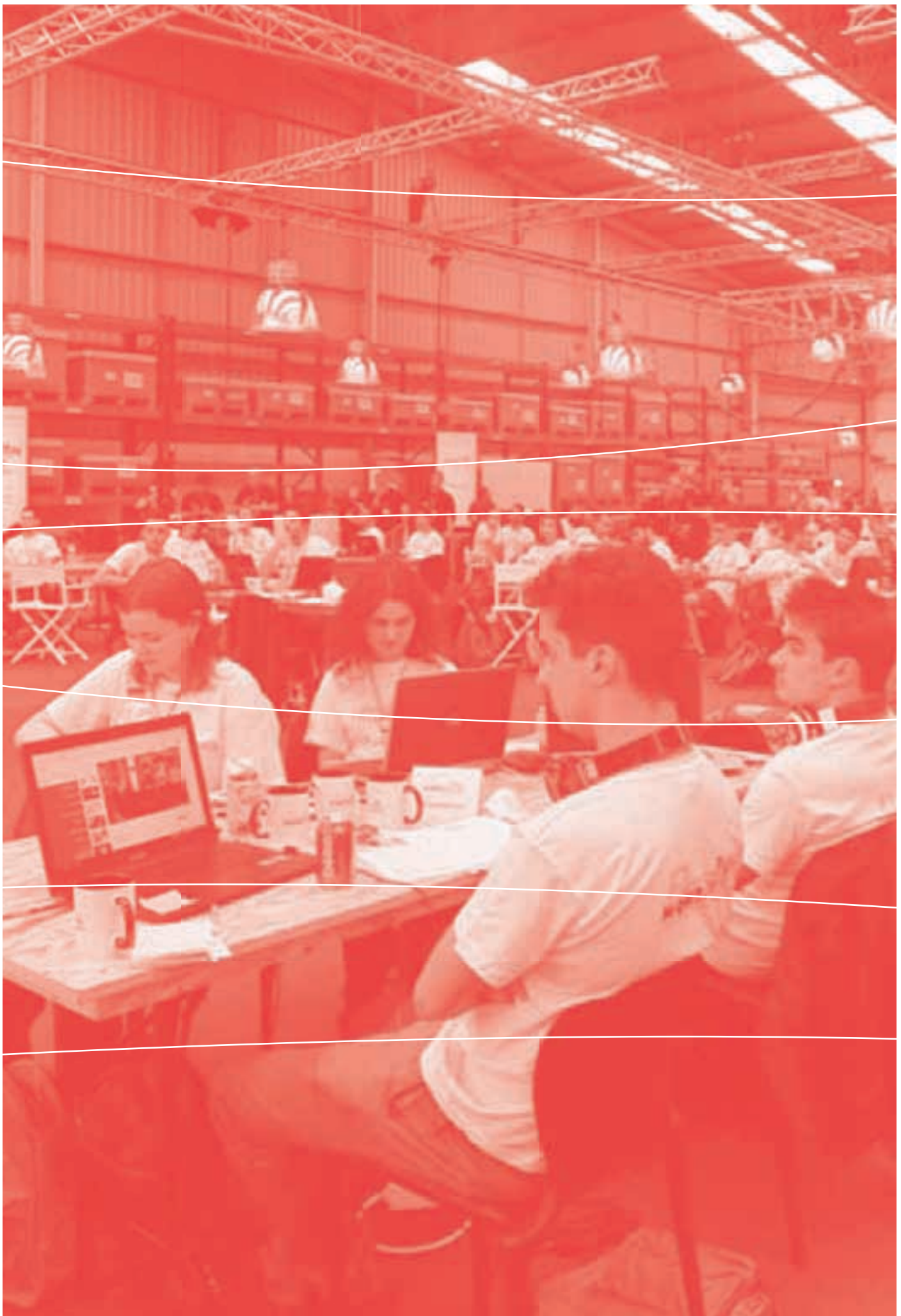
Juan Maria Vazques Rojas	General Secretary of Science and Innovation, Spain
Benjamín Sánchez Gimeno	R&D Senior Advisor , General Secretariat for Science, Technology and Innovation, Spain
Félix García Lausín	Secretaría General Iberoamericana
Jailson Bittencourt	Secretary for Policies and Programs, Ministry for Science, Technology, Innovations and Communications , (MCTIC) Brazil
Andrei Polejack	General Coordinator for Oceans, Antarctic and Geosciences of MCTIC, Brazil
Juan Sanchez	Vice-President for Research, University Texas at Austin USA
José Manuel Fonseca e Moura	Professor, Carnegie Mellon University, USA
Jerry Miller	Science for Decisions, USA
Stewart Bernard	Council of Scientific and Industrial Research, South Africa
Hugo Marques	Foreign & Commonwealth Office, UK
Ekanem John Udoh	Director Science and Technology Promotion, Federal Ministry of Science and Technology, Nigeria
Piero Messina	Strategy & Portugal Country Desk Officer, European Space Agency
Aquilino Varela	Director of Science, Technology and Innovation Cabinet, Cape Verde
Satheesh Chandra Sheno	Director, Indian National Centre for Ocean Information Services (INCOIS), India
S. Rakesh	Chairman, ANTRIX, India
Arjun Dehore	Embassy of India in Lisbon, India
Mariano Jordán	Director for Cooperation and Institutional Integration of the Ministry for Science, Technology and Productive Innovation, Argentina
Víctor Enrique Marzari	Undersecretariat for the Malvinas, Antarctica and South Atlantic Islands of the Ministry for Foreign Affairs and Worship , Argentina
Alexandre Costa	Director of Interchange and International Relations, Ministry for Science and Technology, Angola
Francisco Wallenstein Macedo	Azores Regional Secretariat for Sea, Science and Technology
Paulo Ferrão	Portuguese Foundation for Science and Technology (Chair)
Ana Quartin	Foundation for Science and Technology
Sofia Cordeiro	Foundation for Science and Technology
Carolina Rêgo Costa	Cabinet of the Minister for Science, Technology and Higher Education
Teresa Tavares	Cabinet of the Minister for Science, Technology and Higher Education
Susana Catita	Cabinet of the Minister for Science, Technology and Higher Education







High Level Meeting on
«A new era of Blue Enlightenment»
and Belém Statement on Atlantic Ocean
Research and Innovation Cooperation,
July 12-13, 2017



“A new era of Blue Enlightenment”
and Belém Statement on Atlantic Ocean
Research and Innovation Cooperation
AGENDA

BUILDING AN ATLANTIC COMMUNITY: PROJECTS AND IDEAS MEETING PLACE

Altis Belém Hotel

12TH JULY - PARALLEL SESSIONS

09:30 – 11:00	MEETING ROOM 1	MEETING ROOM 2	MEETING ROOM 2
	Sustainably Harvesting Our Marine Resources DiscardLess, PrimeFish, ClimeFish, MareFrame, FAO Contact persons: Guðmundur Stefánsson, Lisa Borges, Rosa Chapela, Malcolm Beveridge	Atlantic Ocean Research Alliance Coordination and Support Action (AORA-CSA) Contact persons: Margaret Rae, Patricia Killian	Connecting to better observe the Atlantic Ocean AtlantOS PREFACE Contact persons: Sabrina Speich, Mahaut de Vareilles
11:00 – 12:30	International Council for the Exploration of the Sea (ICES) Contact person: Mark Dickey-Collas	Ocean Literacy ResponSEABLE Sea Change Contact persons: Celia Quico, Ana Noronha	
11:00 – 12:30	NETWORKING LUNCH		
	Euro Marine Network Contact person: Isabel Sousa Pinto	INCOBRA EU – Brazil Cooperation Contact persons: Sara Medina and André Barbosa	Connecting to better observe the Atlantic Ocean AtlantOS PREFACE
16:15 – 16:30	COFFEE BREAK		
16:30 – 18:00	Tara Oceans Contact person: André Abreu	Mercator Ocean Copernicus Contact person: Pierre Bahurel	Connecting to better observe the Atlantic Ocean
18:00 – 19:00	Trans North Atlantic Research and Prospects for South Atlantic Partnership ATLAS, SponGES, Mercedes Contact persons: Katherine Simpson, Joana Xavier	An Ocean of Impact – How to create an ocean friendly economy Ocean Impact Alliance Contact person: Peter Royers	AtlantOS PREFACE
19:30	L	L	L

12:00 - 12:15**Closing of the Morning Session:**

Ana Paula Vitorino, Minister of Sea, Portugal

BUILDING AN ATLANTIC COMMUNITY: PROJECTS AND IDEAS MEETING PLACE

Champalimaud Foundation Congress Centre & Belém Tower

13th JULY 2017

Moderator of the Event:

Karen Coleman**08:00 - 08:45 • REGISTRATION AND WELCOME COFFEE****08:45 – 09:00 • VIDEO - PROMOTING THE VALUES OF THE ATLANTIC OCEAN****09:00 - 10:00 • WELCOME SPEECHES:****Carlos Moedas**, European Commissioner for Research, Science and Innovation**Naledi Pandor**, Minister of Science and Technology, South Africa**Gilberto Kassab**, Minister of State for Science, Technology, Innovations and Communications, Brazil**Manuel Heitor**, Minister of Science, Technology and Higher-Education, Portugal**10:00 – 10:15 • KEYNOTE SPEECH:****David Walton**, Chief Scientist, Antarctic Circumnavigation Expedition (ACE), Switzerland**10:15 – 11:00 FROM VISION TO ACTION, FROM CHALLENGES TO OPPORTUNITIES****João Aguiar Machado**, Director-General for Maritime Affairs and Fisheries, European Commission**John Bell**, Director of Bioeconomy, Directorate-General for Research and Innovation,
European Commission**Jailson Bittencourt de Andrade**, Secretary for R&D Policies and Programmes,

Ministry of Science, Technology, Innovations and Communications – MCTIC, Brazil

Thomas Auf der Heyde, Deputy Director-General: Research Development and Support,
Department of Science and Technology, South Africa**Félix García Lausín** Director of the Iberoamerican Knowledge Space,
Iberoamerican General Secretariat (SEGIB), Spain**11:00 – 11:15 • NETWORKING COFFEE BREAK****11:15 – 12:00 • ENGAGING FOUNDATIONS AND THE PRIVATE SECTOR****Tiago Pitta e Cunha**, Chief Executive Officer, Oceano Azul Foundation, Portugal**André Abreu**, Head for Environment and Climate, Tara Expeditions, France**Michael B. Jones**, President, The Maritime Alliance, United States of America**Pedro Escudero**, Chief Executive Officer, Buggy Power, Portugal**Roberto Marcondes**, Adjunct Coordinator for Research Collaborations,
The São Paulo Research Foundation, FAPESP, Brazil

12:15– 13:45 • NETWORKING LUNCH**12:15 • SIGNING CEREMONY OF THE BELÉM STATEMENT**

Limited to invited guests only

13:45 – 15:30 • ENHANCING OCEAN OBSERVATIONS IN THE ATLANTIC: ROM ANTARCTICA TO THE ARCTIC**PROJECTS SHOWCASE****Martin Visbeck**, AtlantOS – a Horizon 2020 funded project**Ned Dwyer**, INTAROS - a Horizon 2020 funded project**Nuno Lourenço**, Atlantic Seabed Mapping International Working Group**Moacyr Araujo**, Federal University of Pernambuco, Prediction and Research Moored Array in the Tropical Atlantic, (PIRATA), Brazil**Edmo Campos**, Senior Professor, SÃO PAULO UNIVERSITY, Brazil & Isabelle**Ansonge**, Head of oceanography department, University of Cape Town, South Africa. South Atlantic Meridional Overturning Circulation (SAMOC), Brazil**Pedro Monteiro**, CSIR, SOCCO-SOSCEX-GoodHope2018+, South Africa**ROUNDTABLE DISCUSSION****Gilles Bessero**, Director, International Hydrographic Organisation, Monaco**Pierre-Yves Le Traon**, Scientific Director, Mercator Ocean, France**Emily Smail**, Blue Planet Scientific Coordinator, United States of America**Paulo Nobre**, Researcher, National Institute for Space Research, Brazil**Alakendra Roychoudhury**, Geotraces, Stellenbosch University, South Africa**RAPPORTEURS:****Sabrina Speich**, Ecole normale supérieure, France**Leticia Coltrin**, State University of Rio de Janeiro, Brazil**Issufo Halo**, Cape Peninsula University of Technology, South Africa**15:30 – 15:45 • NETWORKING COFFEE BREAK****15:45 – 17:00 • ROUNDTABLE DISCUSSION:****Striving Synergies****Remarks from:****Dirk Schories**, Project Management Agency for the Federal Ministry of Education and Research, Juelich Research Centre, Germany**Gilles Lericolais**, Director of European and International Affairs, IFREMER, France**Pablo Abaunza**, Deputy Director, Spanish Institute of Oceanography, Spain**Pier Francesco Moretti**, CNR, Italy**Paulo Ferrão**, President of the Board of Directors, FCT – Fundação para a Ciência e a Tecnologia, Portugal**Glenn Nolan**, Secretary General, European Global Ocean Observing System (EOOS), Belgium**Rapporteur:**

Laura Mc Donagh, European Commission

17:00 – 18:30 • ROUNDTABLE DISCUSSION:

New Marine Value Chains for Atlantic Communities





Projects Showcase

Isabelle Arzul, VIVALDI – a Horizon 2020 funded project

AnnaKristín Daníelsdóttir, MareFrame – an FP7 funded project

and ClimeFish – a Horizon 2020 funded project

Philippe Potin, GENIALG – a Horizon 2020 funded project

Carlos Magno, Brazilian Agricultural Research Corporation EMBRAPA, Brazil

Brett Macey, Department of Agriculture, Forestry and Fisheries,

SA Key Aquaculture Research, South Africa

Roundtable Discussion

General Secretary, European Aquaculture Technology and Innovation Platform, Belgium

Øyvind Fylling-Jensen, Managing Director, NOFIMA, Norway

Wagner Valenti, Senior Research Scientist and Professor, Universidade Estadual de São Paulo, Brazil

Fábio Hazin, Professor, Federal Rural University of Pernambuco, Brazil

Beleman Semoli, Director, Aquaculture and Economic Development,

Department of Agriculture, Forestry and Fisheries, South Africa

Rapporteurs:

Jacques Fuchs, Retired Official, European Commission

Rodrigo Roubach, Ministry of Science, Technology, Innovations and Communications – MCTIC, Brazil

Mthuthuzeli Gulekana, Department of Environmental Affairs,

SA Oceans Ecosystems Research, South Africa

Networking Cocktail Reception offered by Manuel Heitor,

Minister of Science, Technology and Higher-Education, Portugal

Transportation will be provided from the Champalimaud Foundation Congress Centre to the Networking Cocktail Reception, Palácio das Laranjeiras - Estrada das Laranjeiras, 205, 1649-018 Lisbon









R&D Agenda on «Atlantic Interactions»



HITE PAPER STEERING COMMITTEE

appointed at the
High-level Industry-Science-Government Dialogue Towards the Atlantic International Research Center (AIR Center)
Terceira, Azores, 20-21 April 2017

Juan Maria oaz; ues Rojas, General Secretary of Science and Innovation, Spain;
Jailson Bittencourt, Secretary for Policies and Programs, Brazil
Patrick Heimback, University of Texas at Austin, USA;
Stewart Bernard, Council of Scientific and Industrial Research, South Africa;
Paulo Ferrão, President, Portuguese Foundation for Science and Technology (Chair)

PREPARATOR RESEARCH RORUSHOPSJ

1. Institute of International Education (IIE), New York City – US, June 10th 2016
2. University of Azores, Ponta Delgada, Azores – PT, June 27th 2016
3. "Portugal Science Summit, Ci+ncia 2016", Lisbon – PT, July 4th 2016
4. European Space Agency (ESA), Paris – FR, August 29th 2016
5. Technological Park, São José dos Campos – BR, September 6th 2016
6. Portuguese Permanent Representation to the EC, Brussels – BE, September 19th 2016
7. Maloka, Bogotá – CO, October 5th 2016
8. Cartagena de Indias – CO, October 6th 2016
9. Brazil Space Agency, Brasília – BR, October, 31st 2016
10. MIT, Cambridge, Mass – US, November, 6th 2016
11. University of Texas at Austin, Texas – US, November, 9th 2016
12. ISRO, Bangalore – IN, January 8th 2017
13. Luanda – AO, January 30th 2017
14. Lagos – NG, February 1st 2017
15. Abuja – NG, February 2nd 2017

OTHER HIGH QUALITY EVENTS

16. Terceira Island, Azores – PT, April 20th-21st 2017
17. Postdam – DE, May 22nd 2017
18. Gran Canaria – SP, June 20th 2017
19. Lisbon – PT, July 14th 2017

Scientific Committee - Group of international experts contributing to the white paper

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- **Ana Colalão**, Institute of Marine Research, Azores, PT
- **Andrei Polejack**, Ministry of Science, Technology and Innovation, BR
- **Byron Tapley**, The University of Texas at Austin, US
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- **Daniel Stanzione**, The University of Texas at Austin, US
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- **Robert Peterson**, The University of Texas at Austin, US
- **Sally MacFarlane**, Department of Energy, US
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- **Tony Lewis**, University College Cork, IE
- **Zong-Liang Gang**, The University of Texas at Austin, US



PREFACE

A commitment to knowledge through global science and technology cooperation

Manuel Heitor

Minister for Science, Technology and Higher Education, Portugal

The preparation of this Scientific and Technological Agenda has been associated with an open and new debate about multilateral cooperation in complex systems engineering and science towards an integrative approach to space, climate-energy and oceans sciences in the Atlantic, together with emerging methods of data science management. The ultimate goal is to help building the future through an effective commitment to knowledge through global and north-south / south-north cooperation.

We are entering critical times that require the creation of conditions for the strengthening of knowledge-based international cooperation. Lessons learned over the last decades with international partnerships in science, technology and higher education, including those established over the last decades between Portuguese and US Universities, among many other Intergovernmental scientific ventures, have clearly shown that the future can only be built based on an exchanged of solid knowledge, skills and ideas.

A new paradigm of structured international research relationships is emerging, which is shaped by a new era of Government and Industry intervention in association with scientific knowledge. Cross-disciplinary new frontier research should be the result of ambitious initiatives yet to be stimulated and developed from the huge potential of Intergovernmental research laboratories and joint ventures. It is under this context that the debate of the potential installation of an Atlantic International Research Center (AIR Centre) is focused on. This debate is centered under two main priorities: i) new data collection for innovative research; and ii) space, climate, oceans and data sciences synergies towards new knowledge production and diffusion.

Our ambition is driven by an increased perception by society of the growing evidence for the potential benefits resulting from the human, social and economic appropriation of the results and methods of science. We aim to stimulate the necessary knowledge-driven conditions to build an Intergovernmental research center with strong international cooperation, taking advantage of the strategic positioning of Atlantic islands by establishing a network of research sites in Azores, Madeira, Canary Islands, Fernando Noronha and S. Pedro-S. Paulo, in Brazil, Cape Verde, as well as in others to follow, thus increasing operational efficiencies by optimising the appropriate use and sharing of research infrastructures, and access to and management of data and platforms. By promoting new knowledge on climate change and related issues in the Atlantic, we are fostering conditions to provide the world with more science, more knowledge and more scientific culture.

The exceptional position of Azores and other Atlantic islands stimulates the access to new frontiers of knowledge, together with the development of new space and marine industries. For example, facilitating the access to Space from the unique position of the Azores, promoting access to new frontiers of knowledge, together with the development of new space industries, should be promoted in coming years to entrepreneurs worldwide. Also, by promoting new research in the deep-sea of Azores and in other Atlantic regions we facilitate the access to a better understanding of living organisms in extreme environments and also of non-living resources.

Moving towards the goal of sustainability requires fundamental changes in human behavior as well as more knowledge and more scientific culture, ensuring the access to science and education as an inalienable right of all. More science and the systematic democratization of access to knowledge mean more equal opportunities, more social mobility and a new stimulus for entrepreneurial activities and well-being.



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Part I

Atlantic InteractionsJ A vision to better understand the interconnected North and South Atlantic through international cooperation

The imperative of building **knowledge-based societies** demands an investment in our collective institutions to enable them to provide worldwide access to quality science education and scientific practices to everyone, regardless of age, origin or social and economic background. People at large will need to access knowledge and modern learning practices at all ages to build future generations who are becoming increasingly knowledgeable, creative and able to adapt responsibly to the challenges of a rapidly changing world. The future of different people on earth is woven in a single garment. We all gain from the joy and benefits of discovery when all people participate in learning and the productive use of knowledge. This means reaching out and engaging our colleagues, scientists and lay people with young people in all parts of the world.

The impending environmental challenges on the Atlantic Ocean and beyond find us at a historical crossroads, with the opportunities brought by the accelerated pace of data production and sharing, the digital plugging-in of Northern and Southern hemispheres and the coming-of-age of scientific communities all around the Atlantic align to create *Intellectual commons* around the *natural commons*. The Atlantic is a mega-regional space, the understanding of which, in all its physical, chemical and biological complexity will be a bold, flagship project for the World. Its sheer size and significance of the challenge will mobilize countries and the private sector, and the success of the initiative will propel other nations to follow globally.

The need to foster and further develop knowledge in Atlantic region in terms of related natural resources, ecosystems dynamics and the interdependences with human activities towards achieving the 2030 United Nations Goals for Sustainable Development, together with the potential exploration of new avenues for knowledge-based economies in south and north Atlantic is the drive of the **Atlantic Interactions** initiative.

The **Atlantic Interactions**, an initiative initiated by Portuguese Government in 2016, builds on the achievements on Atlantic related research over the last five years such as the Galway Statement on Atlantic Ocean Cooperation, signed on 23 May 2013 between the European Union, the United States and Canada, which enabled the alignment of ocean observation efforts, as well as the priorities and actions outlined in the Atlantic Ocean Research Alliance. It also recognizes the progress achieved by Southern Atlantic nations in discussing and establishing a scientific agenda for the Tropical and South Atlantic and the Southern Ocean.

It builds on the results of the series of scientific workshops on Atlantic Interactions held throughout 2016 in New York, Ponta Delgada, Lisbon, Brussels, Paris, Brasília, Cartagena, Bogotá, Cambridge (Mass) and Austin (Texas), as well as other related meetings in Bangalore (India), Luanda (Angola) and Abuja (Nigeria) that have mobilized researchers worldwide towards the development of a new science and technology agenda for an integrative approach to the Atlantic focused on space and ocean sciences and technologies, as well as the implications of climate change and the development of sustainable energy systems.

More recently, it builds on the conclusions of the High-Level Industry-Science-Government Dialogue on Atlantic Interactions held in Terceira Island on the 20-21 April 2017 where it was recognized the need of an **integrative approach to space, climate change and energy, earth and ocean sciences in the Atlantic**, together with emerging methods of **data science, data visualization and science communication** to better understand the emerging issues associated to climate change and the sustainable management of common resources affecting our planet and the lives, prosperity and wellbeing of our citizens. A better use of the strategic positioning of Atlantic islands and a better use of existing infrastructures and initiative would also contribute to the vision of the Atlantic Interactions initiative taking advantage of natural commons and empowering those who are already working to tackle global Atlantic issues.

Atlantic Interactions is therefore a new initiative to unleash the potential of the Atlantic for Society. It considers the Atlantic as a “moonshot project” fostering knowledge-driven solutions for Atlantic and Global Societal challenges that require interdisciplinary research and innovation of complex Earth systems through international cooperation targeting the Atlantic.

This White Paper proposes a **Science and Technology Agenda for the Atlantic integrating Space, Atmospheric, Climate-Energy, Ocean and Data thematic areas** in order to reach the Atlantic Interactions vision ultimately benefiting decision-makers, public users, universities and industry, and fostering highly skilled human resources, the exchange of research infrastructures and technology transfer contributing to the sustainable growth of our countries and regions.

1. A holistic and integrative approach to the Atlantic

The Atlantic Region can be considered as stretching from Norway down to the southern shore of South Africa and Brazil, encompassing parts of the American continent, European continent and African continent. The Atlantic Ocean is the body of water that links all of the countries in the Atlantic Region. It is an interconnected system without physical boundaries that, together with all the other Earth Oceans, should be addressed as a whole, as stated in the United Nations Convention on the Law of the Sea¹. The idea of an interconnected system takes us to a new dimension of science and technology where a holistic and integrative **approach is needed**.

A holistic and integrative approach entails the alignment of national strategies through **international cooperation**. This idea is in line with the 2030 Agenda For Sustainable Development and its Goals² which addresses, besides others, the need of international scientific and technological cooperation to achieve a sustainable development of our society.

The Atlantic Ocean comprises about 20% of the Earth's surface, and is still understudied in terms of its natural resources, ecosystems dynamics and the interdependences with human activities. An alignment of research strategies through international cooperation will allow a better understanding of the Atlantic Ocean dynamics and emerging issues associated to climate change and the sustainable management of common resources affecting our planet and the lives, prosperity and wellbeing of our citizens.

Interdisciplinary research able to face today's challenges and the economic transitions, in particular environmental changes, security conditions, natural hazards, and other human dimensions, calls for the design of an international partnership that aims for resilience and sustainability for the Atlantic and related North-South / South-North cooperation in the five thematic areas represented in Figure 1.

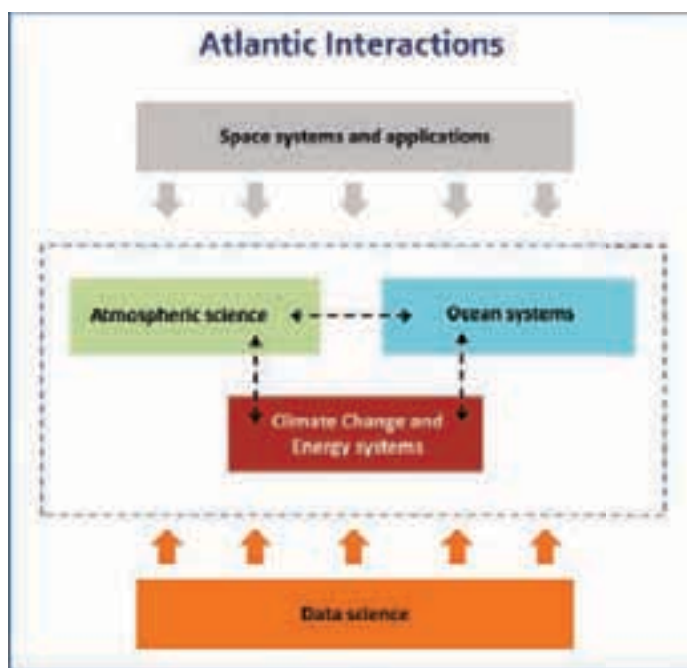


Fig. 1 – Five thematic areas covered by the Atlantic Interactions initiative.

The interaction among the thematic areas covered by the Atlantic Interactions initiative, Space, Atmosphere, Climate-Energy, Oceans and Data domains, will allow **knowledge and technology developments to understand interactions** of atmosphere-ocean and climate changes making use of advanced space and ocean science and technology.

A shared and international environment supporting North-South / South-North cooperation in science and technology, following this integrative approach will require the development of advanced data and network systems, including integrated

¹ http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

² <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>

sensors and monitoring systems over space, air, ground and ocean domains, that allow sustained data gathering to produce better and more precise models which can supply all scientific disciplines involved in order to accurately projecting the future sustainable pathways.

This requires a sustained and globally distributed ocean-observing system, especially at depths where very few observations currently exist, as well as detailed measurements of atmospheric circulation changes, greenhouse gas emissions along with the determination of the Earth's key ecosystems activities and the development of technology to fit science needs. Space applications can help to address great challenges such as climate change, natural hazards, energy dependency and sustainable ocean exploitation as they can provide unique and critical global information for many environmental and climate variables enabling, for example, a sustainable management of marine resources, as well as characterization of the renewable energy potential in islands and coastal environments.

In order to create the desirable positive impact of the knowledge obtained through the *Atlantic Interactions* initiative to the general public we need to bring to the center of our attention all those in the “margins” of knowledge driven societies and knowledge-based economic activities by promoting **scientific literacy**.

A holistic and integrative approach to Space, Atmosphere, Climate-Energy, Oceans and Data thematic areas in the Atlantic can **tackle several interdisciplinary research challenges in the Atlantic region** actively contributing to the Sustainable Development Goals, namely to:

- **SDG 2** – End hunger, achieve food security and improved nutrition and **promote sustainable agriculture**,
- **SDG b** – Ensure access to affordable, reliable, **sustainable and modern energy** for all,
- **SDG 11** – Make **cities** and human settlements inclusive, safe, **resilient and sustainable**,
- **SDG 13** – Take urgent action to **combat climate change and its impacts**,
- **SDG 14** – **Conserve and sustainably use the oceans**, seas and marine resources.

And this intergovernmental effort inherently contributes to:

- **SDG 1b** – **Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development**

2. Maximizing the potential of Atlantic Islands

Islands are extremely well placed to enable the advances of frontier research in the 21st Century. Darwin's expedition to the Galapagos Islands is the paradigmatic example, given the paramount influence it had on the practice of modern science, and how it highlighted the importance of islands and archipelagos for scientific progress.

By providing relatively small but complete ecosystems islands are perfectly suitable for **holistic research studies**. They can be seen as natural living laboratories that enable and facilitate the design of scientific studies of international relevance. Island research stations are ideal for validating concepts, techniques, and methodologies, particularly in remote places and /or in circumstances where reliable platforms are scarce.

The strategic positioning of Atlantic islands can play a critical role in the development of the holistic and integrated approach to research under **the Atlantic Interactions** initiative by establishing a network of island research sites. For example, symbiotic datasets among the Azores, Madeira, Canary Islands, Cape Verde and São Pedro e São Paulo, for example, can provide flux measurements that single point data sets cannot.

A network of Atlantic islands research sites would also maximize the strategic position of Atlantic islands to respond to global challenges and fostering scientific and technological developments not only for Atlantic countries but also to ultra-peripheral regions. For example, **a network of islands research sites** can play a central role in the global geodetic observing system (GGOS), underpinning the North-South, East-West cooperation by incorporating infrastructure and data to support global change research in the context of Earth system sciences (Fig. 2).

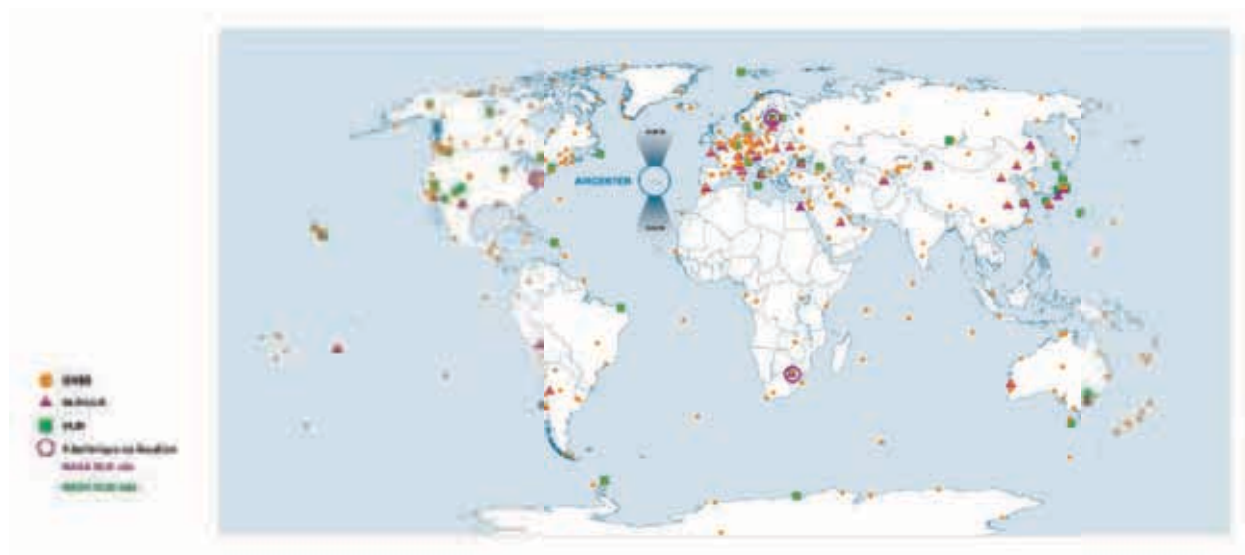


Fig. 2 – The Global Geodetic Observing System (GGOS) and all its core sites

Source: Juan Sanchez, The University of Texas at Austin, US

The enlargement of the above-mentioned network of Atlantic islands research sites to coastal research sites would increase research operational efficiencies by optimising the appropriate use and sharing of research infrastructures, and access to and management of data and platforms (Fig. 3). **This network of research sites** can include 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.



Fig. 3 – Illustration of a possible network of Atlantic Research Stations under the Atlantic Interactions initiative

3. Leveraging the potential of existing infrastructures and initiatives

The development of Research Infrastructures has been, traditionally and still today, to a large extent, based more on the national interest of the hosting countries than on common, global challenges. This has resulted, on the one hand, in a certain level of redundancy, with similar types of facilities in different countries, conducting essentially the same type of research and, on the other hand, in a lack of resources to tackle “moonshot projects”, of global significance. The emerging concept of the *Natural Commons* has added a level of co-responsibility, which brought nations together in tackling common scientific matters.

The Atlantic Ocean is a Natural Commons for the peoples on its shores, who greatly depend on its resources, but also for the World at large, due to the inter-connectedness of the natural systems it is a part of, including adjacent oceans namely the Mediterranean, the Indian and the Pacific. The global atmospheric and ocean cycles influence and are greatly influenced by what happens at the Atlantic, and the planetary climatic change under way is a cause for, and a consequence of changes in the Atlantic.

In 2013 the realization of the common interest in the Atlantic by the European Commission, the United States of America and Canada has led to the signing of the Galway statement, from which projects have emanated to align research strategies (AORA³), observation capabilities and inter-operationalization (AtlantOS⁴), as well as joint efforts to characterize the common resources, to foster sustainable exploitation (ATLAS⁵). The sustainability of this approach to the Atlantic Ocean requires that steps be taken to extend activities beyond the 2020 award period, in an internationally-coordinated way, taking the findings of such projects into account, but bringing other countries and actors into the fold as well. In that sense, the upcoming Belém Declaration is expected to catalyze the integration of South Atlantic Nations in the Atlantic Commons framework.

The *Atlantic Interactions* initiative is fostering the scientific agenda to be implemented under the institutional framework of an intergovernmental organization, the Atlantic International Research Center – AIR Center which, as discussed later, will provide the governance required for the enlargement of the Atlantic Commons actors and their co-accountability, as well as to the expansion in scope of the ongoing initiatives, in order to take space technologies and energy systems into the fold, as well as accounting for the data systems powering the Intellectual Commons being built under the framework of the EOSC.

Inspired by the success of large-scale intergovernmental Research Infrastructures, such as CERN, ESA or ESO, the creation, in 2002, of the **European Strategy Forum on Research Infrastructures (ESFRI)**⁶ has brought EU countries to the table, to plan together the Research Infrastructures of European relevance, in several thematic areas. Today, Europe leads in the policy-making and planning of Research Infrastructures and has 50 pan-European Research Infrastructures/projects in the ESFRI 2016 Roadmap⁷.

The ESFRI Roadmap has identified a solid complement of Environmental / Biomedical / Energy Research Infrastructures, several of which being relevant to the Atlantic Interactions thematic areas (Fig. 4). Some of these Research Infrastructures, such as EPOS (European Plate Observing System⁸) and IAGOS (In-service Aircraft for a Global Observing System⁹) have been put forward as Research Infrastructures of Global Interest, by the Group of Senior Officials (GSO) of the G8. Other Research Infrastructures of global interest have been identified by the GSO in Canada (Ocean Networks Canada¹⁰, WindEEE¹¹) and the United States of America (Ocean Observatories Initiative¹², the Joides Resolution Drill Ship¹³) and other non-Atlantic countries, such as Japan (ocean drilling vessel Chikyu¹⁴).

³ <https://www.atlanticresource.org/aora/>

⁴ <https://www.atlantos-h2020.eu/>

⁵ <http://www.eu-atlas.org/>

⁶ http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri

⁷ <http://www.esfri.eu/roadmap-2016>

⁸ <https://www.epos-ip.org/>

⁹ <http://www.iagos.org/>

¹⁰ <http://www.oceannetworks.ca/>

¹¹ <http://www.eng.uwo.ca/windeee/>

¹² <http://oceanobservatories.org/>

¹³ <http://joidesresolution.org/>

¹⁴ <http://www.jamstec.go.jp/chikyu/e/>

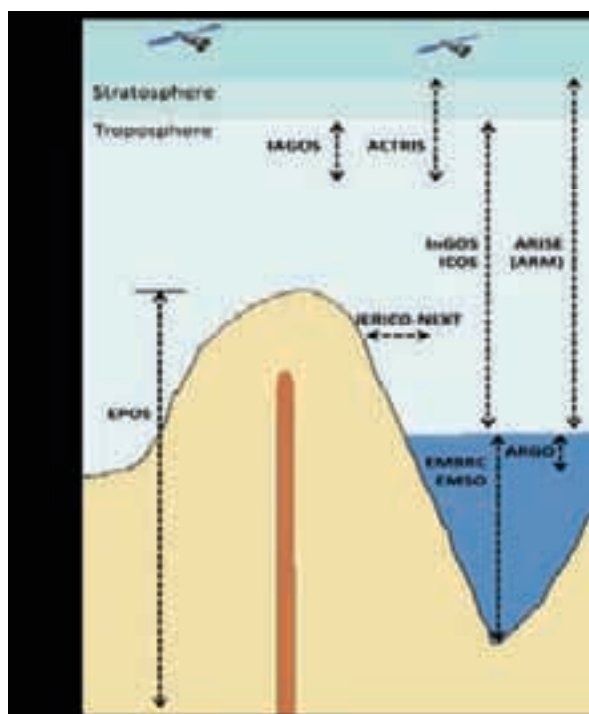


Fig.4 – Illustration of European Infrastructures¹⁵ within the Atlantic Interactions thematic areas

Besides the Research Infrastructures labeled as “of global interest”, regionally relevant and, in some cases, truly unique equipment and infrastructure exist in many of the Atlantic nations. The research vessels coordinated under the EUROFLEETS project¹⁶ and the airborne research aircraft coordinated under the EUFAR project¹⁷ are European examples, with counterparts in other quadrants of the Atlantic Ocean. Others are already truly global endeavors, such as the ARGO program¹⁸ and other initiatives grouped under the GOOS (Global Ocean Observing System)¹⁹ umbrella, as well as the European Union Copernicus Earth Observation program²⁰ and its American counterpart Landsat²¹.

The current and future scientific challenges are increasingly complex and multi-disciplinary, with a big focus on data. The vision for **Open Innovation, Open Science, Open to the World** starts to materialize in the **European Open Science Cloud (EOSC)**²² which, despite its European anchor, is truly a globally relevant structure, which will operationalize an Intellectual Commons.

¹⁵ **EMBR** – European Marine Biological Resource Centre: a distributed research infrastructure that aims to provide a strategic delivery mechanism for excellent and large-scale marine science in Europe.

EMSO – European Multidisciplinary Seafloor and water column Observatory: main scientific objective of long-term monitoring, mainly in real-time, of environmental processes related to the interaction between the geosphere, biosphere, and hydrosphere.

ACTRIS – Aerosols, Clouds, and Trace gases Research Infrastructure Network: Atlantic circulation of Aerosols and trace gases; study shallow marine clouds.

IAGOS – IAGOS is a new European Research Infrastructure conducting long-term observations of atmospheric composition, aerosol and cloud particles on a global scale from commercial aircraft of internationally operating airlines

InGOS – InGOS is an EU FP7 funded Integrating Activity (IA) project targeted at improving and extending the European observation capacity for non-CO2 greenhouse gases.

ICOS – The Integrated Carbon Observing System (ICOS) is a pan-European Research Infrastructure which provides harmonized and high precision scientific data on Carbon Cycle and Greenhouse Gas budget and perturbations.

ARISE – The aim of ARISE is to provide observations and models for future assimilation of data by operational weather forecasting models in the perspective of improving weather forecasting to monthly or seasonal timescales.

JERICO-Next – The vision of JERICO-Next is to improve and innovate the cooperation in coastal observatories in Europe by implementing the coastal part of a European Ocean Observing System, to cooperate with other European initiatives.

EPOS – European Plate Observing System: The activities of the European Plate Observing System span a wide range of themes related to Solid Earth Science, such as Near-Fault and Geomagnetic Observations, Seismology, Geological Modeling, Volcanology, GNSS and Satellite data, among others.

EURO-ARGO – active coordination and strengthening of the European contribution to the international Argo program.

¹⁶ <http://www.eurofleets.eu/np4/home.html>

¹⁷ <http://www.eufar.net/>

¹⁸ <http://www.argo.ucsd.edu/>

¹⁹ <http://www.goosoocean.org/>

²⁰ <http://www.copernicus.eu/>

²¹ <https://landsat.gsfc.nasa.gov/>

²² <https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud>

These are exciting times for research. The move towards openness is unrelenting, and the increasingly connected scientific world will all benefit. Europe has led in the creation of the **data networks** in South America (Red Clara) and Africa (WACREN, ASREN, UbuntuNet Alliance). The “BELLA” EU-Brazil cable, under construction, as well as the AfricaConnect and EUMedconnect EU-Africa links are plugging Africa and Latin America to Europe (through Gf ANT), and realizing on the ground the network for the Global Science Cloud. Researchers in Montevideo, Lagos, Cape Town or São Paulo will have access to the same data, at great connection speeds, as those in Boston, Lisbon or Cork.

[Include information of national research Infrastructures / initiatives of relevance from the results obtained from the matrix to be filled in by the nations]

This new data-intensive research model, operating under the intellectual commons paradigm, will unlock the scientific and economic potential of the research infrastructures. The Atlantic is the “moonshot project” bounded by the polygon defined by Africa, the Americas and Europe. On its shores, there is the Research Infrastructure necessary to study it, from the deep ocean to the high atmosphere. Framed by the work of the IOC-UNESCO, the Galway and the Belém statements, and with a view for UN’s SDGs, the G7’s Tsukuba Communiqué and OECD’s Ocean Economy study, as well as other national/regional policy papers and studies, the *Atlantic Interactions* initiative will leverage this rich complement of hardware and software to understand and respect the Atlantic and to realize its potential for sustainably supporting its citizen welfare and sustainable development.

Part II

A Scientific and Technological Agenda integrating Space, Atmosphere, Climate-Energy, Oceans and Data thematic areas

The *Atlantic Interactions* vision aims to sustainably manage the Atlantic, our common resource, and unleash its potential to society. This common resource can only be holistically managed through a sound research and technological agenda integrating different thematic areas as Space, Atmospheric, Climate-Energy, Oceans and Data. This chapter includes contributions received from the scientific and technological community from June 2016 to April 2017 identifying several interdisciplinary scientific and technological key activities to foster knowledge-driven solutions facing Atlantic Global societal challenges. For a better organization of this chapter the identified key activities were grouped in three main Global challenges requesting integration among different thematic areas:

1. Understanding, predicting and adapting to climate change and atmosphere dynamics
2. Understanding the Atlantic Ocean system and its natural resources for a healthy and productive ocean
3. Increase the share of renewable energy in the global energy mix and improvement in energy efficiency

These Global challenges will be supported by technological applications in the space allowing for an effective collection of mega-sets of data. The collected data will then be integrated and efficiently curated, analyzed and visualized using appropriate data science tools, amplifying the research developed in the Atlantic region. In order to foster the interest and mobilize younger generations for science and technology, as well as to contribute to the education of society in general, literacy issues have also been considered by the scientific community as a crosscutting activity that cannot be disregarded in the *Atlantic Interactions* agenda.

Among the key research activities identified up to now by the scientific and technological communities we can find both fundamental scientific activities, allowing more knowledge towards achieving the *Atlantic Interactions* vision, and technological activities, aiming to support the scientific activities and develop innovative products.

The key scientific and technological activities identified will require a strong disciplinary interaction among Space, Atmospheric, Ocean, Energy-Climate and data systems. They will be leveraged by the use of existing research efforts and infrastructures and may take advantage of a network of islands, for example as test-beds.

The Atlantic Interactions research agenda will act as a catalyst for science and innovation in multiple domains ranging from renewable energies, to the interactions of the oceans with atmosphere and global climate phenomena, to the impacts of global changes on ocean and the deep-sea including their biodiversity, as well on the blue economy. More suitable and coordinated data is also needed to improve knowledge on climate change and related issues in the Atlantic region. The smart use of space systems and applications can help to provide such suitable data. Satellite-based technologies can for example contribute to mitigate risks as they can measure several ocean and atmospheric variables. In fact, the democratization of the access to space has become a research and development-intensive sector open to many players, with significant opportunities for science-based innovation and “new space industries” in a wide range of applications.

In the domain of data science, solving problems and answering questions through data analytics is standard practice. Often, data scientists construct a model to predict outcomes or discover underlying patterns, with the goal of gaining insights. There are numerous rapidly evolving technologies for data analysis and building models. In a remarkably short time, they have progressed from desktops to massively parallel warehouses with huge data volumes and in-database analytic functionality in relational databases. Text analytics on unstructured or semi-structured data is becoming increasingly important as a way to incorporate sentiment and other useful information from text into predictive models, often leading to significant improvements in model quality and accuracy.

4. Key activities identified by the scientific and technological community facing Global challenges in the domains of climate change, ocean and Energy

The key activities identified by the scientific and technological community were grouped in the following three main Global challenges requesting integration among different thematic areas.

4.1 Global challenge I Understanding, predicting and adapting to climate change and atmosphere dynamics

A better understanding, an increased accurate prediction, a resilient and increasingly adaptive capacity to climate-related hazards and natural disasters will be crucial to better place the Atlantic region to face climate change effects.

Such a holistic challenge requires the interaction of several disciplines through a sound international cooperation allowing the share of already existing research and technological efforts and infrastructures. It also requires fundamental knowledge still missing in areas as such atmospheric and ocean sciences.

Identified scientific and technological key activities that could be pursued by the Atlantic Interactions initiative to achieve this goal:

- Research to understand global, regional and local climatic patterns and climate change impacts
- Integrate atmospheric and ocean information in global climate models
- Monitor the large-scale Atlantic subtropical gyre circulation variability
- Development of a regional earth system model for the Atlantic Ocean
- Research to understand the effects of aerosols in the cloud condensation nuclei (CCN) budget
- Research to understand cloudiness transitions through the integration of in situ ground based, airborne and satellite data
- Monitor the influx of atmospheric pollutants in the Atlantic region
- Understand the influence of climate change in fishing
- Understand the influence of climate change in agriculture
- Use the high number of lakes available in different islands of Azores to reconstruct the climate of the Holocene, including the NAO and AMO

4.2 Global challenge II Understanding the Atlantic Ocean system and its natural resources for a healthy and productive ocean

A healthy and productive Atlantic Ocean would not only increase the quality of life of Atlantic countries citizens as well as unleash the economic potential of this common resource to earth inhabitants. A healthy and productive ocean requires a sustainable management of its resources and the protection of its marine and coastal ecosystems to avoid significant adverse impacts. In order to do so, increased knowledge on the ocean processes and its biological and mineral resources is needed as well as the development of innovative approaches to marine technologies allowing a sustained, persistent and affordable presence in the oceans.

Identified scientific and technological key activities that could be pursued by the *Atlantic Interactions* initiative to achieve this goal:

- Build knowledge on the deep ocean
- Develop knowledge on the ocean soundscape around the Azores
- Develop efforts to conserve marine biodiversity

- Explore activities for a sustainable use of the oceans and promoting the blue growth
- Use blue biotechnology to sustainably exploit biological resources, including fishing and aquaculture
- Foster marine technology developments
- Develop a sophisticated data analysis and modeling capability for the Atlantic Ocean
- Observe and monitor the large-scale Atlantic variability and change
- Research to understand major Earth Processes at Ocean Ridges and Ocean Crust Formation

4.3 Global challenge | Increase the share of renewable energy in the global energy mix and improvement in energy efficiency

Energy is the dominant contributor to climate change. An increase of the share of renewable energy and an improvement in energy efficiency can contribute to reduce the global greenhouse gas emissions. An enhanced international cooperation in the area of energy systems in the Atlantic region can promote investment in infrastructure and clean energy technology boosting the economy of its surrounding countries. An improvement in energy efficiency would also contribute to the decrease of fossil-fuel technology.

Identified scientific and technological key activities that could be pursued by the Atlantic Interactions initiative to achieve this goal:

- Develop an integrated monitoring system to better predict the potential of renewable energies with high time resolution
- Develop a micro-grid management tool to exploit the use of high penetration of renewable resources, including distributed generation
- Foster the integration of multiple efficient and flexible storage systems
- Develop a platform to better assess the efficiency of the renewable energy resources in the Atlantic
- Develop tools and systems to predict and manage the energy demand in buildings and large facilities to the availability of renewable energy resources
- Develop new mobility models to foster the efficient use of renewable energies
- Develop a model to design efficient and affordable autonomous sustainable energy systems
- Develop a system to better predict renewable energy assets failure due to weather conditions

5. Enabling activities | Key space applications and data science tools supporting the key research activities facing Global challenges

The above mentioned Global challenges will be supported by technological applications in the space sector allowing an effective collection of mega-sets of data. The collected data will then be integrated and efficiently curated, analyzed and visualized using appropriate data science and digital media tools, amplifying the research developed in the Atlantic region and its understanding by the general public and decision makers.

5.1 Enabling activities | Space systems and applications domain

Space systems and applications can contribute to the above Global challenges through the use of **mega constellations and small satellites** to closely study and monitor the ocean and the atmosphere. Regarding the oceans, satellites can tell us about ocean bathymetry, sea surface temperature, ocean color, coral reefs, and sea and lake ice. Transmitters on satellites also relay position information from emergency beacons to help save lives when people are in distress on boats, airplanes, or in remote areas.

An important aspect of the launch of systems to space is its high cost. Therefore, a key activity should be to foster an affordable access to space, which includes the **launching of small satellites that allow frequent and regular information on the Atlantic** to the benefit of all citizens on planet Earth. The global demand for coverage by micro and nano satellites emphasizes the need for a polar launch infrastructure. The Azores geo-strategic position would provide conditions for both take off and return-to-earth for horizontal launch vehicles. A launch site in the Azores for mega constellations and small satellites will provide many new opportunities, as, for example:

- It will create a pull effect for new companies working on new propulsion systems, small launcher development, ground segment for space, lower cost launches, and satellite validation and calibration, among other themes;
- It can serve as a launch and landing facility for an orbital space plane (long runways). Example: Lages airfield was a backup landing site for the U.S. space shuttle;
- It will provide a comprehensive launch capability for nano/micro satellites (payload development, testing and integration services; satellite platform production, integration, testing; constellation networking and operation services; data reception, storage, analysis and dissemination);

- Spacecraft design and testing and the development of novel technology and experiments for the International Space Station (ISS) will be possible;
- It will facilitate the assembly of satellites and subsystems and can serve as a data-hub for data processing for EO satellites in close interaction with on-site observation capabilities with aircraft, unmanned aerial vehicles (UAVs), ships, and remotely operated vehicles/autonomous underwater vehicles (AUV);
- It can serve as a research hub for conception and development of human spaceflight demonstration projects ² development and improvement of materials and manufacturing processes for the purpose of space exploration (protection of spaceships, astronaut protection, protection against corrosion and wear, exposure to extreme conditions) and science- specific experiments that utilize the orbiting spacecraft environment.

In order to collect useful data, it is important to **define international collector requirements for satellite monitoring systems**. These collector requirements could feed into future satellite generations as part of the Constellation of Constellations Initiative of UNOOSA, EU-Copernicus and others.

In terms of applications, data collected from space can help to better understand the impact of climate change in the Atlantic. Past, current and future satellite remote sensing data have been successfully processed to produce daily-to-monthly composites of these parameters on both regional and global scales. In addition to being decisive information for studies of regional and global climate change – weather and climate monitoring and forecasting, time-series of SST (sea surface temperature) composites, SSH (sea surface height) and most recently SSS (sea surface salinity) – this information is applicable to a number of application areas such as providing support for the analysis of mesoscale variability at the scale of ocean basins affecting fishing activities in the Atlantic ocean current and wave height as an aid in maritime ship routing.

Synthesis of these diverse observational data streams into a **unifying modeling, analysis, and prediction framework** would provide a powerful way to enhance the value of these data. The data reception capacity enables real time reception of the satellite data allowing for the development of a more immediate answer to both anthropogenic and natural hazards. In addition, the near real time products would provide a basis for commercial exploitation of the data that can be developed and could be a basis for small business startups. The real-time data acquisition can foster the collaboration with US, European, African and South American activities, such as a consortium that formed the European Gravity Service for Improved Emergency Management (EGSIEM). The EGSIEM is a multi-institutional effort to **improve the response time for regional emergencies**. The Atlantic Interactions initiative can be important an important spot for similar regional remote sense-data applications.

Space systems can also provide Earth Observation data. This data can be used for innovative geo-information services that can promote transversal initiatives with applicability in many areas related to coastal and ocean management. The analysis of this data could be use on the response to the challenges of promotion, growth and competitiveness of the maritime economy, in line with the European Commission initiatives such as Blue Growth.

Data obtained from space systems can also serve to improve safety in the Atlantic. Space related technologies could cover the following activities:

- Monitoring piracy, illegal and narco activities in Gulf of Guinea & Africa west coast;
- Supporting search and rescue (SAR) Atlantic activities;
- Supporting scientific missions and new economic endeavors;
- Conducting research and testing for UAVs for maritime applications, including a staging and deployment site for regional campaigns.
- Risk prevention in coastal cities.

The *Atlantic Interactions* could also foster the creation and management of a ground facility with high resolution radars for the monitoring of active and obsolete satellites (space junk/debris). This facility could be a “mirror site” for example of the Haystack radar of MIT Lincoln Laboratory imaging at W band for NORAD (North American Radar Air Defence). The availability of high resolution images of virtually everything in orbit could be managed as a service.

The Atlantic Interactions initiative can benefit from the development and implementation of a large antenna of 15.5 meters in Santa Maria Island – Azores, and the development of a new infrastructure to accommodate activities for the Space Surveillance and Tracking (SST) program and NATO's Future Surveillance Control Project/AGS.

A summary of the Identified scientific and technological key activities that could be pursued by the Atlantic Interactions initiative to support the Global challenges in Chapter 4:

- **Reduce the cost of access to space for the launching of small satellites**
- **Acting as a regional collector of requirements for satellite monitoring systems**
- **Establish innovative geo-information services based in Earth Observation (EO) data for adoption and enhancement of the EU Atlantic Strategy (in particular EU Horizon 2020 project AtlanticOSN) and its action plan and of National Ocean Strategies**
- **Installation of an operational network / platform for an efficient Atmosphere - ocean monitoring and environmental management**
- **Establish a Surveillance platform / network to leverage the scientific leadership in the Atlantic**

5.2 Enabling activities Data science and data visualization domains

Science exploration at the *Atlantic Interactions* will generate complex and extensive data that must be analyzed properly to extract knowledge. Data science is focused on extracting knowledge or insights from data in various forms, either structured or unstructured.

Data science can contribute to the above Global challenges through the **development of cognitive processes** combining existing models based on physical properties and large and heterogeneous data sets. The product resulted from these cognitive processes, for research and/or commercial purposes, should be trustable and could for example increase the efficiency and development of several industries.

In addition to extract knowledge from data, it is important that the extracted knowledge is understood by scientists, decision makers and the broad public. Data visualization is therefore quite pertinent to the Atlantic Interactions initiative as it can explain and educate the importance of the driven research to policy makers, researchers and the general public in a visual and interactive way. This understanding process could even be extended to areas such as interactive simulations, “serious games” meaning video games currently in use by industry for education, scientific exploration, health care, emergency management, urban planning, and engineering. These can augment and add to the scientific effort of the Atlantic Interactions as it relates to the willing participation and involvement of the general public.

A scale data collection curation and storage with advanced computing and analysis could also help to achieve the above Global challenges as researchers and practitioners could find the main research information on the Atlantic region in only one place, which may constitute “AIR Hubs”. This **Research Cloud for the Atlantic** should follow the principles of EOSI and could be designed and deployed to integrate a comprehensive set of tools and technologies linking the science and engineering relevant to the *Atlantic Interactions* initiative. It should become a widely used and an indispensable site of reference for the international research community, policy makers and the public in general.

The Research Cloud for the Atlantic can support all the thematic areas of the Atlantic as a technological platform and data hub responsible for providing (Fig. 5):

- A portal, iAtlantic, for web access to host applications providing data and services for science and engineering applications including a directory for search and browse;
- Real-time data collection from several maritime sensors and information sources (land, sea, air and space) that already exist and also from others to be developed;
- Data correlation and fusion through advanced computational models;
- Data storage and retrieval capabilities enabled by big data distributed databases;
- Open interfaces allowing the research and commercial stakeholders build their own services on top of collected data, core cloud services and third parties hosted services;
- Rapid prototyping environment providing core functionalities such as imagery processing, machine learning and business intelligence;

- Application and services hosting;
- Reliable electronic information exchange between stakeholders (including connection to national and international data exchange networks).



Fig.5 – High-level architecture representation for the Atlantic Interactions Research Cloud

The architecture depicted in Figure 5 can be efficiently set-up based on existing assets to support Atlantic-related operations such as data collection from several sensors (space, land and sea), data fusion through advanced computational models, storage and dissemination.

Science exploration at the *Atlantic Interactions* will generate complex and extensive data that must be analyzed properly to extract knowledge. As data science is focused on extracting knowledge or insights from data in various forms, either structured or unstructured, this endeavor is simultaneous processing of this data, towards its understanding by the scientists and broad public constituencies.

A summary of the Identified scientific and technological key activities that could be pursued by the *Atlantic Interactions* initiative to support the Global challenges in Chapter 4:

- Create a best in class Data Science team to extract value from Data, including Data scientists, Data engineers / Data software developers, Data solutions architects, Data platform administrators, Full-stack developers, Designers, Product managers and Project managers
- Design and develop a content analytics platform and methodologies to apply cognitive analytics solutions
- Develop a cognitive process to predict future ocean conditions using a combination of physically-based models and large, heterogeneous data sets
- Design and develop of cognitive security solutions to manage cybersecurity threads and keep data trustable
- Develop data visualization tools to promote understanding of the collected and analyzed data
- Integrate at scale, data collection curation, and storage with advanced computing and analysis – development of a Research Cloud dedicated to the Atlantic, the iAtlantic
- Integrate scientific models to promote an holistic analysis over climate-energy-atmosphere-ocean interactions

6. Crosscutting activities

6.1 Atlantic Ocean Coastal Cities Network (AOCCN) - The City-Ocean Interface

Considering that most of the population lives in coastal cities, whose prosperity is largely dependent on the interactions between oceans/climate/energy/atmosphere, which motivates the Atlantic Interactions initiative, there is a basis to call for the development of a formal network of coastal cities as a subset of the larger Atlantic International Research Center (AIR). The Atlantic Ocean Coastal Cities Network (AOCCN) will catalyze research and foster action on solutions for coastal cities of the Atlantic Ocean in mitigating carbon emissions and adapting to the challenges of climate change. The main focus of the work will be the sea-land interface at the location of major cities along the multi-continental edge of the Atlantic Ocean. Therefore, the partners in this work will be a group of major cities, their municipal governments and associated academic and business partners situated in each member city.

The primary outcome will be the formulation and development of coupled technology-policy actions that deliver economic and equitable solutions for protecting cities through adaptation to climate change while advancing aggressive greenhouse gas mitigation strategies. The Network could proceed through three distinct mechanisms:

- 1) collaborative and directed research ventures;
- 2) regular convening for solutions and;
- 3) community exchange and focused visits.

The first mechanism will prompt the formulation, funding, and staffing of research topics of greatest urgency and relevance to member cities. This will entail a process of vetting and refining proposals that include international participation by both researchers and member cities. The second mechanism will involve regular convening in different locations of the multidisciplinary network comprised of municipal authorities, business leaders, academics, NGOs, and others with a productive participatory role in advancing solutions. The third mechanism puts in place various exchanges of people from one city to another and from one type of organization to another for maximum collaborative understanding of the priorities to be found in each distinct sector.

This proposal is founded on the belief that a fundamental element of AIR is the role of cities in understanding the Atlantic as both a complex natural system and a bridge between the distinct economies, cultures, histories and priorities of bordering countries.

6.2 Addressing technology transfer

The activities in scope of the *Atlantic Interactions* initiative will foster an innovative and entrepreneurial environment that would be characterized as a “start-up campus” for innovation resulted of the holistic approach implemented. For example, NewSpace companies, considered as “high-risk, high-reward” from an investment view point, could take advantage of this entrepreneurial environment. This innovative environment will create appropriate conditions for attracting private investors and will be a perfect place to build capacity and impact the Atlantic’s economy.

6.3 Promoting scientific literacy/ Knowledge for Space – Space for Unknowledge

The Atlantic Interactions initiative includes the urgent need to foster knowledge as our common future, and recognize the need to bring to the center stage all those in the margins of knowledge and knowledge-based economic activities as a way to increase social and gender equality and fostering inclusion for everyone, everywhere, anytime.

Scientific literacy has therefore also been tackled by the scientific and technological community as a crosscutting activity to foster the interest and mobilize younger generations for science and technology. The power of literacy lies not just in the ability to read and write, but rather in a person’s capacity to apply these skills to effectively connect, interpret and discern the intricacies of the world in which they live.

To promote science and innovation for all, the agenda should include an activity fostering education and knowledge aimed to promote **Unknowledge for Space and its integration with ocean, earth and climate education in a holistic approach**. This initiative should extend traditional education and science awareness programs to consider new horizons of space technologies in order to foster the access to education for all. This will be achieved by involving telecom operators, broadcast services and space providers in a “Space for Knowledge” network.

Although “star wars” program days are gone, in today’s world space activities are still very much perceived by the general public as a dispute for outer space conquests of “rocket” scientists. **The majority of the world’s population is unaware of the importance of space activities in our daily lives.** This is in fact a highly relevant theme in today’s societies because space science involves a series of disciplines that provide new insights on the Universe (physics; astronomy); allows perceiving earth dynamics which helps in the prediction and preparation for emerging threats; foster new advancements in satellites and robotic engineering, as well as in related technology allowing the exploration of outer space and find new materials and new knowledge of the Universe. A better use of space science and technology opens opportunity for new ventures with economic, environmental and social impact. The impact of a better use space application could foster innovation and developments in fisheries and aquaculture, maritime safety, managements of common resources/goods and foster renewable energy potential as it integrates different areas of knowledge.

It is under this context that several major initiatives have been launched worldwide in the last decades to foster education for space in an effort to bridging the knowledge gap between people and space science. For example, in 2002, UNESCO launched a Space Education program²³ following recommendations from the 1999 World Conference on Science and the Third United Nations Conference on the Peaceful Uses of Outer Space²⁴. It is aimed to enhance space subjects and disciplines in schools and university curricula, the improvement of teaching methodologies to raise awareness about the importance of space and space related activities to human development.

To carry out these objectives, UNESCO develops space education workshops and other initiatives that show the importance of the peaceful uses of outer space and the role played by space uses and technology in protecting, monitoring, documenting, and sharing our common heritage, both cultural and natural.

In a related action, ESA launched the ESERO initiative²⁵ (European Space Education Resource Office) with several nations, including activities to help teachers introducing space in the classroom and raising awareness in schools of the importance of space science and technology. Among other initiatives, it has provided teacher-training courses, with special emphasis to primary level education and the reinforcement of the communication between the scientific community, enterprises and schools.

The United Nations Office for Outer Space Affairs (UNOOSA) is the United Nations office responsible for promoting international cooperation in the peaceful uses of outer space and has an extensive capacity-building role achieved through different programs and initiatives. The *Atlantic Interactions* could complement and partner with UNOOSA to deliver capacity-building efforts to developing countries.

By using space as an engaging multidisciplinary challenge, these initiatives are contributing to promote the interest and mobilization of younger generations for science and technology.

Through the initiative **Knowledge for Space – Space for knowledge** the Atlantic Interactions will aim to expand and complement existing activities at UNESCO, ESA, NASA and other major players worldwide to raise awareness for the natural, physical and engineering sciences among children, but also to deliver new educational and cultural contents in developing countries through space technologies. Specific activities will aim to promote the diffusion of endogenous knowledge of local cultural and natural heritages, and contributing for educating more children everywhere, all the time.

A sustainable future requires more knowledge and more scientific culture, ensuring the access to science and education as an inalienable right of all.

²³ <http://www.unesco.org/new/en/natural-sciences/science-technology/space-activities/related-info/about-sep/>

²⁴ <http://www.unoosa.org/oosa/en/ourwork/psa/schedule/1999/unispace-iii.html>

²⁵ http://www.esa.int/Education/Teachers_Corner/European_Space_Education_Resource_Office

b.A Scientific and technological agenda – A visual approach

UE IDENTIFIED ACTIVITIES	ATLANTIC INTERACTIONS THEMATIC AREAS				
	SPACE SYSTEMS AND APPLICATIONS	ATMOSPHERIC SCIENCE	OCEAN SCIENCE	CLIMATE CHANGE AND ENERGY SYSTEMS	DATA SYSTEMS
GLOBAL CHALLENGE 1 UNDERSTANDING, PREDICTING AND ADAPTING TO CLIMATE CHANGE					
Research to understand global, regional and local climatic patterns and climate change impacts		▲	▲	▲	
Integrate atmospheric and ocean information in global climate models		▲	▲	▲	
Monitor the large-scale Atlantic subtropical gyre circulation variability		▲	▲	▲	
Development of a regional earth system model for the Atlantic Ocean		▲		▲	
Research to understand the effects of aerosols in the cloud condensation nuclei (CCN) budget	▲	▲		▲	
Research to understand cloudiness transitions through the integration of in situ ground based, airborne and satellite data		▲			
Monitor the influx of atmospheric pollutants in the Atlantic region		▲		▲	
Use the high number of lakes available in different islands of Azores to reconstruct the climate of the Holocene, including the NAO and AMO				▲	
GLOBAL CHALLENGE 2 UNDERSTANDING THE ATLANTIC OCEAN SYSTEM AND ITS NATURAL RESOURCES FOR A HEALTHY AND PRODUCTIVE OCEAN					
Build knowledge on the deep ocean	▲		▲	▲	▲
Develop knowledge on the ocean soundscape around the Azores			▲	▲	▲
Develop efforts to conserve marine biodiversity			▲	▲	
Explore activities for a sustainable use of the oceans and promoting the blue growth			▲	▲	
Use blue biotechnology to sustainably exploit biological resources			▲	▲	
Foster marine technology developments			▲	▲	
Develop a sophisticated data analysis and modeling capability for the Atlantic Ocean	▲	▲	▲	▲	▲

UEG IDENTIFIED ACTIvITIES	ATLANTIC INTERACTIONS THEMATIC AREAS				
	SPACE SGSTEMS AND APPLICATIONS	ATMOSPHERIC SCIENCE	OCEAN SCIENCE	CLIMATE CHANGE AND ENERGG SGSTEMS	DATA SGSTEMS
GLOBAL CHALLENGEJ UNDERSTANDING THE ATLANTIC OCEAN SGSTEM AND ITS NATURAL RESOURCES FOR A HEALTHG AND PRODUCTIvE OCEAN WONT.X					
Observe and monitor the large-scale Atlantic variability and change	▲	▲	▲	▲	▲
Research to understand major Earth Processes at Ocean Ridges and Ocean Crust Formation			▲	▲	
GLOBAL CHALLENGEJ INCREASE THE SHARE OF RENEF ABLE ENERGG IN THE GLOBAL ENERGG MI, AND IMPROvEMENT IN ENERGG EFFICIENCY					
Develop a micro-grid management tool to exploit the use of high penetration of renewable resources, including distributed generation	▲	▲	▲		
Foster the integration of multiple efficient and flexible storage systems	▲	▲	▲		
Develop a plaEorm to better assess the efficiency of the renewable energy resources in the Atlantic				▲	
Develop tools and systems to manage the energy demand in buildings and large facilities to the availability of renewable energy resources				▲	
Develop new mobility models to increase the use of renewable energies				▲	
Develop a system to better predict renewable energy assets failure due to weather conditions				▲	
ENABLING ACTIvITIESJ SPACE SGSTEMS AND APPLICATIONS DOMAIN					
Reduce the cost of access to space for the launching of small satellites	▲	▲	▲	▲	
Acting as a regional collector of requirements for satellite monitoring systems	▲			▲	
Establish innovative geo-information services based in Earth Observation (EO) data for adoption and enhancement of the EU Atlantic Strategy (in particular EU Horizon 2020 project "AtlantOS") and its action plan and of National Ocean Strategies	▲				▲
"Atmosphere - ocean monitoring and environmental management"	▲	▲	▲	▲	▲
UEG IDENTIFIED ACTIvITIES	ATLANTIC INTERACTIONS THEMATIC AREAS				
	SPACE SGSTEMS AND APPLICATIONS	ATMOSPHERIC SCIENCE	OCEAN SCIENCE	CLIMATE CHANGE AND ENERGG SGSTEMS	DATA SGSTEMS
ENABLING ACTIvITIESJ SPACE SGSTEMS AND APPLICATIONS DOMAIN WONT.X					
Establish a Surveillance plaEorm / network to leverage the scientific leadership in the Atlantic	▲		▲		
ENABLING ACTIvITIESJ DATA SCIENCE AND DATA vISUALIZATION DOMAINS					
Create a best in class Data Science team to extract value from Data, including Data scientists, Data engineers / Data software developers, Data solutions architects, Data plaEorm administrators, Full-stack developers, Designers, Product managers and Project managers	▲	▲	▲	▲	▲
Design and develop a content analytics plaEorm and methodologies to apply cognitive analytics solutions		▲	▲	▲	▲
Develop a cognitive process to predict future ocean conditions using a combination of physically-based models and large, heterogeneous data sets		▲			▲
Design and develop of cognitive security solutions to manage cybersecurity threads and keep data trustable					▲
Develop data visualization tools to promote understanding of the collected and analyzed data		▲		▲	▲
Integrate at scale, data collection curation, and storage with advanced computing and analysis – development of a Research Cloud dedicated to the Atlantic, the iAtlantic	▲	▲		▲	▲
CROSSCUTTING ACTIvITIES					
Atlantic Ocean Coastal Cities Network (AOCCN) - The City-Ocean Interface	▲	▲	▲	▲	▲
Addressing technology transfer	▲	▲		▲	▲
Promoting scientific literacy: I knowledge for Space – Space for I knowledge	▲	▲	▲	▲	

Part III

Aligning research strategies through international cooperation in the Atlantic

A “moonshot project” on the Atlantic will require significant research infrastructure and funding. Although the various thematic research infrastructures in countries around the Atlantic have varying degrees of implementation and geographic coverage, the technological capability is in place to allow for a comprehensive thematic study of the ocean area, from the deep bottom to the space above.

Research Infrastructure roadmapping has been spearheaded in Europe, but the practice is spreading elsewhere, with South Africa having recently published their own Research Infrastructure roadmap. A joint EU-CELAC expert group is also being formed to spread best roadmapping practice to Latin American and Caribbean countries. These fora will greatly benefit from the Atlantic Interactions initiative, which will promote an integrative planning process in the Atlantic context, and thus more efficient and with a greater impact on the *AtlantX Commons*.

The **alignment of initiatives and infrastructure** for the *AtlantX Interactions* initiative through international cooperation could be three-fold:

- 1) through the design of a pan-Atlantic research program, leading to coordinated deployment of existing World-class equipment from participating countries, to tackle the big questions on the ground;
- 2) through the continuing work on data standards and inter-operationalization, as well as the coordination of data flow, in the frame of the EOSC²⁶, and in close collaboration with national and supra-national data networks, other e-Infrastructures and organizations such as the Research Data Alliance²⁷ and relevant Research Infrastructures and cluster projects;
- 3) through the joint planning / roadmapping for new research infrastructures.

c. Cost of Not Doing

Overall, the global expenditure on R&D has seen only modest increases in the past few decades. Even though the GDP has grown by an average of 3,26%/year since 2000 in OECD countries²⁸, the share of that GDP going to R&D has grown by a modest 0,75%/year²⁹. Compounded by the realization that doing research is an increasingly costly endeavor, these numbers pose a great challenge and call for increased efficiency in spending, if frontier and global challenges are to be addressed.

One way to increase the efficiency is by coordinating different streams of funding into common goals and research programming. In Europe, a whopping 85% of all research funding is estimated to be spent on national programs, with only 15% dedicated to common, pan-EU endeavors, or global programs, such as CERN, or the Framework Programs of R&D. This flies in the face of the borderless nature of science.

The successes of such big science projects are very palpable and the scientific community, as well as the public at large, understands the benefits of common pursuits. In an era of limited resources, their fragmentation should be reduced, coalescing around common scientific and societal goals. A harmonious deployment of resources – physical, human and financial – will make it possible to tackle big questions, in the multi-disciplinarity demanded by their complexity. In the current model, we can only achieve very detailed knowledge of some localized phenomena, with large geographic and thematic gaps remaining, and thus a flawed understanding of the natural World.

The *AtlantX Interactions* initiative will fulfill several of those thematic and frontier gaps bring new knowledge-driven solutions to Atlantic, and possibly global societal challenges at a much lower cost if every nation had to perform similar activities on its own.

d.Aligning infrastructures and initiatives

[This section will be further developed with information from the results obtained from the matrix to be filled in by the nations (EC DGs and UN offices). The idea is to develop a schematic figure/image and some text, if suitable.]

Through an alignment of existing infrastructures and initiatives the *AtlantX Interactions* initiative will **bring added value to**

²⁶ <https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud>

²⁷ <https://www.rd-alliance.org/>

²⁸ <https://data.oecd.org/gdp/gross-domestic-product-gdp.htm>

²⁹ <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>



[Detailed information on how the infrastructures and initiatives could contribute to the Atlantic Interactions agenda can be found in Annex I.]

[This section will be further developed with information from the results obtained from the matrix to be filled in by the nations (EC DGs and UN offices). The idea is to develop tables and some text, if suitable.]

When tackling larger-than-national scientific questions, it is increasingly common to use mixed funding schemes, in order to enable the very existence of the projects, or to allow the participation of researchers from different origins in common scientific endeavors. In **Europe, Joint Programming Initiatives (JPIs)** have recently been deployed to align the financial instruments of Member States around common-interest research issues. Likewise, **ERA-Nets** (Member States-European Commission co-funding mechanisms) have proliferated in recent years, which have allowed the coalescence of funding instruments and research communities across Europe, but have also dispersed funding to many small-scale ventures. The fact that research communities and funding agencies seek international engagement is a very positive realization for global science, as the links that are created can nucleate future common endeavors. But transformative projects require bold common goals and/or financial packages. That is one of the tenets of **Horizon 2020's International Cooperation approach**, which has led to several non-EU countries establishing matching fund schemes for their research communities to participate in formally “European” projects. The main European financial instruments can be found in Table 1.

Source	Primary targets	Type of support
European Structural and Investment Funds	National Authorities	Grants, fellowships, contracts
European Investment Bank	National, Regional Governments, Public and private institutions, SMEs	EFIs, loans, mixed instruments
DG RTD (Horizon 2020)	Universities, Research Organizations, Researchers, SMEs, industry	Grants, fellowships, awards
DG GROW (COSME)	SMEs	Access to finance, markets
DG ENV (LIFE)	Public, private organizations	Grants
DG MARE	Public, private organizations	Grants, tenders
DG DEVCO (EDF, PI, DCI)	Development policy countries (variable)	Grants, projects

Table 1 – Main European financial instruments

The instruments in Table 1 vary in target, scope and budget. The European Structural and Investment Funds (especially ERDF) are the largest package, but sizeable and very relevant programs exist in different Directorates-General. Of the ones listed, the most attractive for the scope of the Atlantic Interactions initiative are the Horizon 2020 Framework Program (DG RTD) and the DG DEVCO instruments, targeting regions bordering the Atlantic Ocean (Partnership Instrument, Development Cooperation Instrument, European Development Fund).

If the instruments of European dimension are complex and difficult to articulate with each other, these have to be looked at in the context of multiple national programs as well, which are endowed with even larger amounts, disbursed through multiple instruments.

Outside of Europe, **bilateral agreements** have allowed some level of scientific common-interest pursuits between nations, but they have also, in some instances, led to a proliferation of instruments, that make it more difficult to tackle large, multi-country projects. To name just two South Atlantic countries, Brazil and South Africa have in place bilateral research cooperation agreements with 30+ countries each. In addition to bilateral agreements, at **national level** there are innumerable funding instruments that could be aligned to fund common challenges. The Atlantic is one such common challenge. The identification of relevant regional, national and supra-national instruments and their coordination around a common agenda will be one of the main focus of this initiative.

[Detailed information on how the financial instruments could contribute to the Atlantic Interactions agenda can be found in Annex II.]

11. Identification of new infrastructures, initiatives and instruments needed to potentiate international cooperation

[This section will be further developed with information from the results obtained from the matrix to be filled in by the nations (EC DGs and UN offices). The idea is to develop tables and some text, if suitable.]

Part IV

Implementation of the Atlantic Interactions vision: Atlantic International Research Center (AIR Center)

The participants of the High-level Industry-Science-Government Dialogue on *Atlantic Interactions* that took place on April 20-21 April 2017 in the Azores (Terceira island) agreed that the **science and technological agenda for an integrative approach to the Atlantic should be implemented through an international network of research, academic and business organizations worldwide**, across both south and north Atlantic countries, as well as non-Atlantic countries, in an international scientific organization, bringing together infrastructures located throughout the Atlantic: the Atlantic International Research Center (AIR Center).

12.The Atlantic International Research Center (AIR Center)

Taking into account the **holistic and integrated approach** of the *Atlantic Interactions* initiative, the AIR Center will consist of an intergovernmental organization, extending the capabilities of research centers around the world and effectively addressing the synergies between Space, Climate-Energy, Oceans and Data Sciences. This approach will pave the way for a sustainable management and exploration of Atlantic common resources. It will also enhance the potential of the existing Atlantic research infrastructures since it would focus on disciplines that combine more than one scientific area, acting as a catalyst for research and innovation in multiple domains ranging from renewable energies, to the interactions of the ocean with the atmosphere and global climate phenomena, the impacts of global changes on the open ocean and the deep sea, including their biodiversity, as well as blue economy.

The AIR Center will also **exploit the potential of the Atlantic Islands** by stimulating the necessary knowledge-driven conditions to better use of their natural resources. A network of Atlantic islands and mainland 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 would increase the operational efficiency of research of technology facing global issues as it would **optimise the appropriate use and sharing of research infrastructures, and access to and management of data and platforms**.

Providing an efficient governance to sound international cooperation will be the basis of the AIR Center. Different forms of scientific and technological collaboration with public and private entities from non-Atlantic countries across the globe are also welcome and will allow the openness of the center to the world. The AIR Center aims to provide a truly international shared environment, which will promote amongst others, the development of comparative studies and projects on other seas, oceans, such as the Indian, Arctic, and Pacific Oceans and the Mediterranean promoting a sustainable management of common resources.

Taking into account the *Atlantic Interactions* initiative vision, the AIR center will accomplish the following goals:

- Promote a new holistic and integrative approach to knowledge on space, climate-energy, oceans and data scientific areas and related issues in the Atlantic, fostering conditions to provide the world with more science, more knowledge and more scientific culture;
- Foster an inclusive approach to science, technology and economic development, bringing to the center of our attention all of those in the "margins" of knowledge driven societies and knowledge-based economic activities;
- Establish a network of research sites in various Atlantic islands in north and south Atlantic, in close interaction with research, academic and business organizations worldwide, including those across both south and north Atlantic countries, as well as non-Atlantic countries;
- Facilitate the access to space data from the unique position of the Azores, promoting access to new frontiers of knowledge, together with the development of new space industries;
- Stimulate the test of new renewable energy sources and their integration in smart networks in islands environments, promoting test beds for the development of new sustainable energy industries;

- Promote new research in deep-sea, facilitating the access to a better understanding of living organisms in extreme environments and new energy and mineral sources;
- Foster the study of earth processes in the Atlantic triple junction, where three major tectonic plates meet, to contribute for the understanding and risk mitigation of the derived natural hazards, namely earthquakes, volcanism, tsunamis;
- Facilitate the establishment and use of new mega-sets of data on climate, atmosphere, earth, ocean and energy related themes stimulating new forms of data science and the development of new technology-based companies oriented towards big data processing and usage;
- Promote and foster the education and knowledge agenda “knowledge for Space – Space for knowledge” and its integration with ocean, earth and climate education in a holistic way, fostering the interest and mobilization of younger generations for science and technology, as well as contributing for educating more children everywhere, anytime.

The central location of Azores in the Atlantic and its proximity to complex oceanographic and ocean-atmosphere interaction processes, the existing expertise in ocean and atmosphere-climate research and the existing research facilities make them a natural headquarter for research. Its complex geological nature and activity, its climate and waves provide alternative energy sources, while its isolated nature is already a stage for energy storage experiments, placing the Azores in a privileged scenario in terms of energetic resource exploitation potential. The meteorological conditions, the large distance from inhabited landmasses, the existing space related infrastructures (European Space agency’s Tracking Station; Galileo Sensor Station, Copernicus Collaborative Station; Earth Observation Station, Atlantic Network of Geodynamical and Space Stations; NAV Portugal Air Traffic Control Center) provide a favorable set of conditions for the implementation of microsatellite launching facilities, thus putting the Azores in a central position in the Space scene. In the given context, the Azores archipelago appears as a natural choice for hosting AIR Center’s headquarters.

Through an enhanced international cooperation among world-wide research institutions, initiatives and the private sector the AIR Center will allow to put in place the ***Atlantic Interaction initiative*** a common approach to address societal challenges and unleash the potential of the Atlantic for science, economy and society.

Annex I – Existing infrastructures and initiatives

[To be further developed and reorganized with information collected from the matrix to be filled in by the countries. At the moment includes information already received from some countries/regions.]

A. PORTUGAL

A.1 Existing Infrastructures and other resources

The text table below presents existing research infrastructures in the Azores as well as the specific island on which they are located. Most of these will be part of the development and implementation of the AIR Center.

	EXISTING INFRASTRUCTURES	ISLAND
SPACE SYSTEMS AND APPLICATIONS	European Space Agency (ESA) Tracking Station	SANTA MARIA
	Galileo Sensor Station	
	Copernicus Collaborative station	
	Earth Observation (EO) station	
	Atlantic Network of Geodynamical and Space stations	
	NAV Portugal Air Traffic Control Center	
	Drone Test Area	
	ESA 15m Antenna	
ATMOSPHERIC SCIENCE AND CLIMATE CHANGE	Atlantic Network of Geodynamical and Space stations (under construction	FLORES
	Observatório Astronómico de Santana	SÃO MIGUEL
	University of Azores - Faculty of Agrarian Sciences and the Environment Laboratories and equipment	TERCEIRA
	José Agostinho Meteorological Observatory	
	Center for Climate, Meteorology and Global Change - Center for Agriculture Research and Technology, University of Azores	
	OAA - Environmental Observatory of Azores	
	Eastern North Atlantic (ENA) Atmospheric Radiation Measurement (ARM) facility, U.S. Department of Energy & University of Azores	GRACIOSA
	Graciosa Meteorological Center	PICO
	Pico Mountain Air Pollution Observatory - North Atlantic Regional Experiment, University of Azores	
	Ponta Delgada Meteorological Observatory	SÃO MIGUEL
	Santa Maria Meteorological Center	MARIA
	Regional Government's network of hidrometeorological sensors	ALL AZORES ISLANDS
	Regional Government's network of air quality monitoring stations	

	EXISTING INFRASTRUCTURES	ISLAND
OCEAN SCIENCE AND TECHNOLOGY	Faculty of Sciences and Technology Laboratories and equipment	FAIAL AND SÃO MIGUEL
	School of Higher Studies in Technology Laboratories and equipment	SÃO MIGUEL
	Highly skilled human resources at the institute of Marine Research based at the Department of Oceanography and Fisheries (DOP)	FAIAL
	Oceanic harbor of Horta	
	DeepSeaLab facility designed to maintain and experiment on deep sea fauna (e.g. from hydrothermal vents and seamounts), under simulated hydrothermal vent (sulphide, methane) and climate change (pH, temperature) scenario conditions	
	Experimental laboratory to research scenarios of climate change on deep sea organisms	
	Experimental high pressure vessel (up to 4000m), to conduct experiments with deep-sea fauna under natural and extreme pressure conditions on the effect of scenarios under pressure.	
	Multi-instrumented permanent deep sea observatories – EMSO: Azores Hydrothermal vent observatory, currently maintained by IFREMER	
	Hydrothermal vent observatory	
	Condor observatory located in the first seamount marine reserve for scientific purposes	
ENERGY SYSTEMS	Deep sea moored array of acoustic receivers for the tracking and monitoring of marine animals	SÃO MIGUEL
	Center for Volcanology and Geological Risk Assessment , University of Azores	
	A wave energy pilot plant run by WavEC: OWC Pico Power Plant (www.pico-owc.net)	PICO
	High penetration of geothermal and wind energy, with pump storage: “Central Geotérmica do Pico Vermelho” and “Central Geotérmica da Ribeira Grande” in São Miguel	SÃO MIGUEL
	The “Most” Hydro Flywheels on Flores: “Central Hidroelétrica da Ribeira Grande” and “Central Hidroelétrica de Além Fazenda”	FLORES
	Flores PowerStore Flywheel Project	GRACIOSA
	Graciosa PowerStore Flywheel Project	
	System of hybrid power (wind and solar), supported by an innovative battery system, that will enable uninterrupted power supply, to be constructed in Graciosa.	

A.2 Potential additional resources

i. Space systems and applications

In addition to the existing space-related infrastructure, there are resources that could be potentially complementary throughout the Atlantic islands that integrate the AIR Center. For instance, an Atlantic spaceport for mini-micro-nano satellite launchers could be situated on the island of Santa Maria, that offers a competitive set of favorable conditions. The fact that Santa Maria hosts a Sentinel data reception facility for the North Atlantic constitutes a great advantage for setting up an Atlantic Data Hub offering EO data storage, processing and dissemination services to serve the whole Atlantic, provided the appropriate communication infrastructure is installed there. Likewise, Santa Maria could host an Atlantic surveillance center, or a high data rate direct broadcast reception facility, and any of the islands could serve as the location of an ESA / Azores launchpad technology incubation facility. A Portuguese candidacy to the European SST consortium is being prepared based on the assumption that Santa Maria or Flores will host a RADAR infrastructure and Graciosa an optical sensor.

POTENTIAL RESOURCES	ISLAND
Atlantic Spaceport for low cost access to Space	Santa Maria
Atlantic Data Hub	Santa Maria
Atlantic Surveillance Center	Santa Maria
Space Surveillance and Tracking Program	Santa Maria/Flores and Graciosa
ESA /Azores Launchpad Technology Incubation facility	All

ii. Atmospheric Science and Climate Change for the Atlantic

In addition to institutional resources, the Azores have numerous non-institutional resources that can potentially be used in the context of the AIR Center. For example, there is the need for a robust cyber-infrastructure that allows accelerating the pace of scientific discovery in climate change research and large scale monitoring, modeling and simulation of Earth phenomena. The proliferation of datasets, modeling tools and the convergence of diverse disciplinary expertise calls for an integrated and efficient approach to data curating, analysis and visualization.

Furthermore, there are relationships (existing and future) that will or could be associated with the AIR Center, such as integration into the European and Global Research Infrastructure landscape, namely, the integration of PICO-NARE in the World Meteorological Organization - Global Atmospheric Watch, and the possible integration of existing infrastructures in Azores for atmosphere science and climate in European infrastructures such as ACTRIS (observation of aerosol, clouds, and trace gases), IAGOS (long-term observations of atmospheric composition, aerosol and cloud particles), ICOS (carbon cycle and greenhouse gas budget and perturbations), and InGOS (improving observation of non-CO₂ greenhouse gases). Additional resources will be required in climate modeling, land surface modeling, observations (from space), computing and data science, and mass data storage to provide the AIR Center's specialized human resources with the optimal research environment. The AIR Center will be a privileged platform to couple observations and model developments in the Atlantic climate. Together with a strong involvement in the global ESM development, which is already in place, a regional modeling facility focused on specific processes that can be assessed in the North or South Atlantic region will increase the impact of research based in the AIR Centre on the global research agenda. Improved infrastructures for observation and monitoring will increase the potential impact of the AIR Center climate studies.

POTENTIAL RESOURCES

A robust cyber-infrastructure that allows accelerating the pace of scientific discovery in climate change research and large scale monitoring, modeling and simulation of Earth phenomena. The proliferation of datasets, modeling tools and the convergence of diverse disciplinary expertise calls for an integrated and efficient approach to data curating, analysis and visualization.

Integration in the European and Global Research Infrastructure Landscape, namely:

- PICO-NARE in the World Meteorological Organization - Global Atmospheric Watch;
- existing infrastructures in Azores for Atmosphere Science and Climate in the European Infrastructures

ACTRIS (Aerosols, Clouds, and Trace gases), IAGOS (In-Service Aircraft for a Global Observing System), ICOS (Integrated Carbon Observing System) and InGOS (Integrated non-CO₂ Greenhouse GAs Observing System).

Specialized human resources

Laboratory for detailed measurement of over 40 greenhouse gases, at high altitude (over 2000 m) at the Pico Island

Multiparametric stations (mooring buoys, eddy correlation towers) for land-atmosphere -ocean fluxes

Surveys for physical and biogeochemical upper ocean sampling

Laboratory for physical and biogeochemical interface processes (Gas Chromatography / Mass Spectrometry, etc.)

High performance computational facilities for data analysis, image processing; numerical modeling

iii. Ocean Science and Technology

There are several potential resources that include land-based facilities (e.g., laboratories, experimentation stations, and monitoring stations) and remote platforms (e.g., vessels, satellites, drifting floats, autonomous underwater vehicles, gliders, underwater robots, receiving devices (and sources) for passive (and/or active) ocean acoustic tomography/thermometry, cabled seabed observatories, instrumented marine mammals. Finally, there are deep-sea and open-ocean long-term fixed point observatories for such targeted contributions as the European Union Horizon 2020 project AtlantOS (Optimizing and Enhancing the Integrated Atlantic Ocean Observing Systems).

POTENTIAL RESOURCES

Land based facilities : laboratories, experimental stations and monitoring stations

Remote platforms: vessels, satellites and underwater robots

Deep sea and open ocean long term fixed point observatories

Equipment: sensors, vehicles and sensors that can operate below 200m

Secure and reinforce high skilled critical mass of researchers through international collaboration

iv. Energy Systems

The Azores also have a range of resources that can be leveraged for experimentation and analysis. As set forth below, some of these resources can be integrated for unique solutions.

POTENTIAL RESOURCES	ISLAND
Geothermal exploration on Terceira: “Central Geotérmica do Pico Alto” planned for 2017	Terceira
Electric Vehicle Deployment Demonstration	All
Flexible, efficient and resilient storage systems (i.e. Integration of power grids hardware to be efficient and resilient; grids that are able to cope with the erratic nature of wind and solar power)	All
Renewable energy technologies deployment demonstration in a confined environment; possible interactions to be established with the Marinerg-i project	
Full scale smart grid management of full scale laboratory aiming at 100% renewable energy	Corvo, Flores and Graciosa
Integration of renewable energy with desalination technologies for simultaneously balancing the grid and providing freshwater.	
Integration of renewable energy with hydrogen production (via electrolysis) or methane production (via methanation) for simultaneously balancing the grid and providing domestic fuels.	All
Ocean thermal energy conversion (OTEC), which uses temperature differences between the ocean surface and depths to generate electricity.	All
Osmotic power, which uses salinity gradients between freshwater onshore with saltwater offshore to generate electricity.	All

v. Data Science

The research community engaged in climate change research and large scale monitoring, modeling and simulation of earth phenomena is keenly aware of the need for a robust cyber-infrastructure in order to accelerate the pace of scientific discovery. In particular, the proliferation of datasets, modeling tools and the convergence of diverse disciplinary expertise calls for an integrated and efficient approach to collecting, curating, analyzing and visualizing data.

The ultimate goal and objective of a robust cyber-infrastructure is to support the mission of the Atlantic International Research Center and to provide enabling tools to researchers and private entrepreneurs in order to maximize their ability to navigate across data sets, computational models and a variety of disciplines. Ideally, the tools should be components that are accessible and of demonstrated value to both policy makers and non-experts in the general public.

The Atlantic Data Hub, mentioned in section 11.2.1.i, while serving the needs of the Copernicus and Galileo Programs, can host AIR Center’s robust cyber-infrastructure, centralizing all data storage, processing and provision to the public, private and scientific public.

B. BRAZIL

The workshop held in Brazil allowed the identification of synergies that fully exemplify the type of cooperation that can be established through the AIR Center, combining national research priorities and the research opportunities presented by international interdisciplinary cooperation for attaining better and more comprehensive datasets for innovative research (Table 3).

	POTENTIAL RESOURCES		
SPACE SCIENCE AND TECHNOLOGY	Satellite launch and operation	Satellite data collection and processing	Interoperability between different computational systems
ATMOSPHERIC SCIENCE	Cloud formation identification mechanisms and modeling	Monitoring of the atmospheric transport of pollutants emitted in the South American and South African continents	
OCEAN SCIENCE AND TECHNOLOGY	Ocean and ocean[atmosphere interaction monitoring programs	Satellite based Oceanography	Ocean technologies and renewable energy
ENERGY SYSTEMS	Data sets to model and design sustainable energy systems: Project SONDA; Project SWERA	Wind forecasting: Project PREVENTO	Public disclosure of renewable energy availability data

Table 3 – Potential Synergies of the Atlantic Research Center with Brazil

In addition, the development of a cooperative agenda between the AIR Center and INPE for capacity building of young undergraduate and graduate students is an imperative for a long-term perspective of scientific and technological aspirations of tackling global issues in areas of space and oceans. Moreover, the possibility of applying technology transfer mechanisms, as foreseen by the i IOC Criteria and Guidelines on Transfer of Marine Technology , would be key to enhance cooperation North to South.

After the meeting in Brazil specific points of cooperation with the State of Ceará were also identified (Table 4):

AREA OF COOPERATION	OBJECTIVE	ORGANIZATION
OCEAN SCIENCE AND TECHNOLOGY	Understanding and determination of impacts suffered by the Oceans and coastal areas as a consequence of economic exploitation of renewable and non-renewable resources.	UFC e LABOMARf, UECE
CLIMATE CHANGE	Use of climate information as a support for public policy and decision making processes for Ceará economic sectors of interest such as agriculture, industry, environment and energy	FUNCEME, UECE e UFC
ENERGY SYSTEMS	Development of technologies of energetic efficiency	IFCE, UNILAB, SINDENERGIA, SECITECE e SEBRAE
DATA SCIENCE	Development of a platform for Ocean monitoring e internet of thingsf] development of specific sensors interconnected used for identification and prediction of phenomena	IFCE, ITIC, UFC e SDBf, UECE e NPTECF, CTI[Ne UFC e SDBf; CTI[Ne; UECE e NPTECF, ITIC
SPACE SCIENCE AND TECHNOLOGY	Development of sensors for space applications	CTI[Ne, ITIC, UECE, IFCE

Table 4 - Potential Synergies of the Atlantic Research Center with Brazilian State of Ceará

Annex I

Financial Instruments

A • PORTUGAL'S ENABLING INFRASTRUCTURES

SPACE SYSTEMS AND APPLICATIONS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	REFERENCE PAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Portuguese infrastructure for storing and providing images of Sentinel satellites	IPSentinel	Direção-Geral do Território; IPMA	The infrastructure IPSentinel provides free and open access to data from Sentinel satellites in the Portuguese territory including the area of responsibility for search and rescue in the Atlantic. It has a privileged quick access (minutes) to Sentinel 1 data through Santa Maria Ground Station. The infrastructure IPSentinel is already aligned with the proposed high-level architecture for the Atlantic Interactions Research Cloud. With some upgrades it could provide computing capabilities.	Operating	https://ipsentinel.ipma.pt/	Enabling Activities 1
	Portuguese ALMA Centre of Expertise	PACE	IA-CAUP, Fci+ncias.IDf	ESO-recognized Centre of Expertise part of the European ALMA Regional Centre, focused on the support and exploitation of the Atacama Large Millimetre Array. PACE supports Portuguese and EU users of ALMA, including with the ALMA archive, and helps ESO validate ALMA data. It includes expertise in data handling and radio astronomy, of relevance for the Atlantic Interactions agenda.	Operating	http://pace.oal.ul.pt/	Enabling Activities 1
	Laboratory of Optics, Lasers and Systems	LOLS	FCUL	Laboratory facility developing multidisciplinary activity for scientific instrumentation. Of particular relevance, the activity in the area of Astronomy and Space Sciences; Computer Vision; Flight Dynamics; Geospatial Information Systems; Image Processing; Lasers and Quantum Electronics; Navigation and Position Fixing; Photodetectors, Optical Sensors and Solar Cells; Photogrammetry and Remote Sensing; Photonics and Electro-Optical Engineering (incl. Communications); Photonics, Optoelectronics and Optical Communications; Satellite, Space Vehicle and Missile Design and Testing; Signal Processing; Simulation and Modelling.	Operating	http://pace.oal.ul.pt/	Enabling Activities 1



INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
Astronomical instruments for ground-based observatories		IA	Future ground based instruments (ESPRESSO, ESO, MOONS, ESO, HIRES, ELT,...): the expertise in the development of state-of-the-art astronomical instruments for ground-based observatories is extremely relevant for the international collaboration in the Atlantic Area considering, in particular, the international observatory of the Canary Islands and potential future space observing facilities in Azores and Madeira	Under Construction	https://ipsentinel.ipma.pt/	Enabling Activities 1
ESA Tracking Station	PACE	EDISOFT	An ESTRACK stations with launcher tracking capability and is used to receive real-time telemetry from launches originating from ESA's spaceport in Kourou, French Guiana. It is capable of tracking Ariane 5, and was first used to track the launch of ESA's Automated Transfer Vehicle ATV Jules Verne in early 2008.	Operating	http://www.esa.int/Our_Activities/Operations/ESTRACK/Santa_Maria_station	Enabling Activities 1
Laboratory of Optics, Lasers and Systems	GSS	Azores Regional Government [EMA (Espaço); EDISOFT	15-metre antenna with transmission and reception in both S and X band.	Under Construction		Enabling Activities 1
Galileo Sensor Station		EDISOFT	.	Operating	http://www.edisoft.pt/	Enabling Activities 1
EUMETSAT Station	EUMETSAT	EDISOFT		Under Construction	http://www.edisoft.pt/	Enabling Activities 1 Global Challenge 1
Atlantic Network of Geodynamical and Space Stations	RAEGE	Azores Regional Government [EMA (Espaço)	Two fundamental geodetic stations (Santa Maria is operational and Flores is under construction); data infrastructure	Planned and Operating	<a]"="" href="http://raege.morfose.net/en/about[us/raege[in[vgosggo/">http://raege.morfose.net/en/about[us/raege[in[vgosggo/	Enabling Activities 1 Global Challenge 1
Permanent Geodesic Station Network of Azores	REPRAA	Azores Regional Government [Directorate for Environment		Operating	http://www.repraa.azores.gov.pt/SpiderWeb/frmlIndex.aspx	Enabling Activities 1 Global Challenge 1
SST Infrastructures	REPRAA	Azores Regional Government [EMA (Espaço)	Optic infrastructure foreseen for Graciosa Island and RADAR infrastructure for Santa Maria Island; possible data centre in Terceira Island	Planned		Enabling Activities 1
SaAelite Launchers/Space Port		ANA Aeroportos		Planned		Enabling Activities 1 Crosscutting activities: Addressing technology transfer
Drone Test Area		ANA Aeroportos	Test area defined in Santa Maria in a protocol between the Azores Government and the airport and air traffic authorities, subscribed by some private companies have signed up.	Operating		Enabling Activities 1
Enabling Green EQscience for Square Kilometer Array	ENGAGE SI A	Instituto de Telecomunicações	ENGAGE SI A implements an action plan coupling frontier research and technological development in close collaboration with the Portuguese industry, promoting the participation of Portugal in the Square Kilometer Array, the largest radio telescope of the XXI century, to be installed in Southern Africa and Australia. ENGAGE SI A offers a wide variety of activities, such as advanced training in radio astronomy, radio frequency and core optical technologies for radioastronomy, training in computational astrophysics, characterization and testing facilities with inclusion of Green Solar technologies, Aperture Array technologies optimization, solar observations (radio and optical), astronomy software development and E-Science, Cloud Computing and Data Storage. It includes: [VLBI techniques for connection with RAEGE + EU/Africa VLBI networks [SST pilots (space debris programs) [SATCOM/DSN techniques (Doppler tracking)	Under Construction	www.engageska.portugal.pt	Enabling Activities 1



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ATMOSPHERIC SCIENCE AND CLIMATE CHANGE THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Portuguese Infrastructure for Information and Research on Biodiversity / Azorean Biodiversity Portal	PORBIOTA / AZORES BIOPORTAL	Owner: Azorean Biodiversity Group Funding Management: Fundação Gaspar Frutuoso	It includes online species spatial distributions at 500 m x 500 m for 6500 marine and terrestrial species for Azores. Scientific and citizen data is available since 1850; Modelling tools will be available for Big Biodiversity Data, useful for modelling the impact of climatic changes on marine and terrestrial ecosystems.	Under Construction	http://azoresbioportal.uac.pt/	Global Challenge 1
	Biodiversity on oceanic islands towards a unified theory	ISLANDLAB	Owner: Azorean Biodiversity Group Funding Management: Fundação Gaspar Frutuoso	Database with a long term ecological study in the natural forest of several Azorean islands aiming to monitor the flying insect fauna in order to understand the impact of climatic changes in the productivity of Azorean native forests.	Under Construction	http://azoresbioportal.uac.pt/	Global Challenge 1
	Eastern North Atlantic Atmospheric Radiation Measurement Facility	ENA / ARM	US Energy Department and University of Azores	It provides the research community with continuous data about clouds, aerosols, energy, and precipitation from Graciosa Island in the Azores, Portugal. Installed by a team from Los Alamos National Laboratory, the new observation site mirrors ARM's other long-term atmospheric measurement stations around the world.	Operating	https://www.arm.gov/news/features/post/23692	Global Challenge 1 Global Challenge 3
	Pico Mountain Air Pollution Observatory Q North Atlantic Regional Experiment	ICO / NARE	University of Azores	An air pollution observatory that allows to study the free atmosphere not directly affected by the ocean and see pollution transport events originating in North America and Europe. The station was developed to study the global impacts of human activities on the atmosphere. It has also proven valuable for learning about the effects of large wild fires in North America and even Siberia.	Operating	http://www.cee.mtu.edu/greh/pico/	Global Challenge 1
	José Agostinho Meteorological Observatory	OJAE	IPMA	Located at the north surroundings of the Angra do Heroísmo town, the facility has near 19100 m2 of area, including a main building observatory with 3 floors and 10 offices. It has also a manual weather station and a automated weather station with 1 technician. It also has a seismic station with 2 technicians.	Operating	http://www.ipma.pt/pt/index.html	Global Challenge 1
	Santa Maria Meteorological Center	LPA	IPMA	Located at the Santa Maria international Airport, the facility consists in a building with only one office, a manual weather station and 2 automated weather stations. It has 6 technicians working in shifts 24/7.	Operating	http://www.ipma.pt/pt/index.html	Global Challenge 1
	Graciosa Meteorological Center	LPGR	IPMA	Located at the Graciosa Aerodrome, the facility consists in an office, a manual weather station and an automated weather station. It has 2 technicians working in shifts.	Operating	http://www.ipma.pt/pt/index.html	Global Challenge 1
	Regional Government's air quality monitoring station		Azores Regional Government [Directorate for the Environment	Equipped with automatic analyzers of atmospheric pollutants, as well as meteorological parameters such as wind speed, temperature, relative humidity, precipitation and solar radiation, allowing evaluation of air quality, based on methods and measurement criteria common throughout the national territory.	Operating	http://www.azores.gov.pt/Gra/srnamambiente/menus/secundario/Eualidade+doAr+Ambiente/	Global Challenge 1
	Meteo Radars		IPMA	3 Meteorological radars operational in mainland Portugal and 1 under construction in Porto Santo Island, Madeira	Operating mainland Portugal Under Construction Porto Santo Island, Madeira Planned to be operational in 2018		Global Challenge 1



OCEAN SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Research vessel Mar Portugal	IPMA		Deep[sea 76m research vessel, certified by Lloyds, for geophysical and remote operated vehicles operations and trawling activities. Capacity for 30 researchers and 15 crew members	Under Construction is being adapted to support fisheries research and ROV operations	http://marportugal.ipma.pt/en/	Global Challenge 1
	Research vessel Arquipélago		Azores Regional Government [Directorate for Fisheries; IMAR	Oceanographic Research Vessel	Operational	http://marportugal.ipma.pt/en/	Global Challenge 1 Global Challenge 2
	Research vessel Ilhas oivas		Azores Regional Government [Directorate for Fisheries; IMAR	Oceanographic Research Vessel	Operating	http://www.horta.uac.pt/port/equipamento/ships_2.html	Global Challenge 1 Global Challenge 2
	Observing Systems in OOS Voluntary Observing Ships in the Portuguese sea	OBSERVA.PT	IPMA	Meteo and oceanographic observations on board commercial voluntary observing ships	Planned	http://www.cee.mtu.edu/greh/pico/	Global Challenge 1 Global Challenge 2
	School of the Sea		Azores Regional Government [Directorate for Maritime Affairs	Professional training in ocean and technology related matters	Operating	http://www.dop.uac.pt/	Global Challenge 2
	DeepSeaLab		University of Azores / IMAR	Facility designed to maintain and experiment on deep sea fauna e.g. from hydrothermal vents and seamounts, under simulated hydrothermal vent sulphide, methane and climate change pH, temperature scenario conditions	Operating	http://www.dop.uac.pt/	Global Challenge 2
	Hydrothermal vent observatory		University of Azores / IMAR		Operating	http://www.dop.uac.pt/	Global Challenge 2
	Condor observatory located in the first seamount marine reserve for scientific purposes		University of Azores / IMAR		Operating	http://www.dop.uac.pt/	Global Challenge 2
	Deep sea moored array of acoustic receivers for the tracking and monitoring of marine animals		University of Azores / IMAR		Operating	http://www.dop.uac.pt/	Global Challenge 2
OCEAN SYSTEMS THEMATIC AREA	Lula 1000		Rebokoff[Niggeler Foundation	The manned submersible LULA1000 carries a crew of 3 to 1000 metres of depth. LULA1000 has been optimized for high quality video and audio documentation and for the collection of oceanographic data and samples.	Operating	http://www.rebokoff.org/	Global Challenge 2
	ADA REBIUOFF		Rebokoff[Niggeler Foundation	The 17m motor catamaran serves as support vessel for diving missions with the LULA1000 submersible. The vessel is used for transporting the sub within the Arquipélago and for towing it from harbour to the dive site. Furthermore, the catamaran is used for missions with the purpose of collecting bathymetric data.	Operating	http://www.rebokoff.org/	Global Challenge 2





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	Rebikoff Niggeler equipment	IPMA	Rebikoff Niggeler Foundation	L3 Communications ELAC NAUTILUS SeaBeam 1050 High Resolution Multibeam; Sonar System; L3 Communications Interleaved System 3000 Digital SideScanSonar and Interleaved Sonar; Workstation; SeaSpy Explorer Marine Magnetometer; CTD 60M Sea and Sun Technology Memory Probe with 4 integrated sensors; TrackLink 1500HA USB/L Acoustic Tracking System; NavEquest 300P DVL eDoppler Velocity Log; Triton Super Seaking DST Digital CHIRP Sonar; Onboard video cameras; Motion Sensor; eInfrastructure: data server with eVideo of image and data bank	Operating	http://www.rebikoff.org/	Global Challenge2
	Observing system in the Gulf of Cadiz	OBSERVATION GoC	IPMA Coordinator + Consortium Portugal/Spain/France	Integrated observing and modelling system in the Gulf of Cadiz	Planned	http://www.rebikoff.org/	Global Challenge2
	Operational Numerical Modelling Applications	ONMA	MARETEC [Instituto Superior Técnico	Operational numerical models are operated in a daily basis to provide with the best forecasts to the area of application and generate a database of previous events that can be accessed a posteriori. Those systems allow to provide services such as oil spills; operation and maintenance eO&M services for Marine Renewable Energy; search and rescue operations or to generate products for fisheries. For the AIR centre two large Atlantic applications can be highlighted: for circulation and waves. The Lusitania application http://forecast.maretec.org/maps_Lusitania.aspx is a General Circulation Model eGCM that covers a wide area of the eastern Atlantic Ocean and the Western Mediterranean Sea. It was designed to provide forecast, analysis and management capacity for the Portuguese EEZ and to supply boundary conditions to the existing operational models that run on a daily basis for the continental region, Madeira and Azores archipelagos. The North Atlantic Area wave forecast is provided by the WaveWatch III operational model application http://forecast.maretec.org/maps_WWIII_ATN.aspx designed for the waves generated in western Atlantic that reach the Portuguese waters and that are latter downscaled to local coastal areas.	Operational	http://forecast.maretec.org/	Global Challenge2
	Marpocs Platforms	MARPOCS	MARETEC [Instituto Superior Técnico	The MARPOCS Platform tries to answer to the need for an integrated framework for preparedness and response to oil and HNS spills. This tool allows integrating: [Operational model hindcast and forecast results for different spatial domains eirculation, meteorology, waves; [Vessel positions and other vessel info are obtained through AIS system; [Field data visualization; [Maps and time series; [On demand marine pollution incident simulations eoil, HNS spills, SARf based on best available information.	Operational	http://marpocs.actionmodulers.com/	Global Challenge2
	Portuguese Coastal Monitoring Network	CoastNet	MARE	CoastNet is designed to improve the understanding of coastal ecosystems functioning and variability through the development of a remote coastal monitoring system. The real time acquisition of relevant chemical, physical and biological variables will allow this valuable information to be integrated in a structured database, which will be available online to the scientific community.	Under Construction	http://marpocs.actionmodulers.com/	Global Challenge2





OCEAN SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	r EBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Research vessel Mar Portugal	IB[S]	University of Minho	IB[S] is a research Institute that aggregates different areas of knowledge such as Biology, Civil Engineering, Electronics, Advanced Materials, Physics and Mathematics. This multidisciplinary team has the goal to find technological solutions for complex societal challenges related with Sustainability. IB[S] can contribute to the Atlantic Interactions agenda since it has significant experience in research projects related with the Oceans and Climate. Also the Institute has a close connection with companies translated by a Strategic Council with representatives of 15 important companies of different areas. Finally, the topic of renewable energies, mainly those produced in the ocean is a topic that is on IB[S] near future research agenda.		www.ib[s.uminho.pt	
	3B's Research Group and European Institute of Excellence on Tissue Engineering and Regenerative Medicine	3B's	University of Minho	The 3B's Research Group & Biomaterials, Biodegradables and Biomimetics develops its activity in the areas of biomaterials, tissue engineering, regenerative medicine, nanomedicine, and stem cell isolation and differentiation. One of its main areas of work is related with the valorization of marine resources and its by[products for the development of applications with high added value, with emphasis on health and well[being. It plays a very important role in the field of marine biotechnology and valorization of marine biological resources following the vision of the sustainable use of marine resources. Its facilities correspond to 2800 m2 completely dedicated to research, with several laboratories & chemistry, materials processing, physical[chemical characterization, morphology, mechanics, microscopy, biology, cell culture, among others. The infrastructure will soon be extended, with the construction of a new building that will host the headquarters of the new Discoveries Center.	Operating	www.ib[s.uminho.pt	Global Challenge 2
	Center for valorization of Technology in Marine Resources Centro de valoriza[ç[o de Tecnologia baseada em Recursos MarinhosX	CVTMar	University of Minho + CM Esposende	CVTMar will be an infrastructure dedicated to the valorization of marine resources and their by[products. It will focus on technological and innovation developments in partnership with the local businesses, aiming to effectively transfer knowledge and technology to industry.	Planned		Global Challenge 2
	Center for valorization of Technology in Marine Resources Centro de valoriza[ç[o de Tecnologia baseada em Recursos MarinhosX	IMCTMar	University of Minho + CM Esposende	MCTMar aims to actively contribute to monitor the North Coast Natural Park and to characterize its marine ecosystem, to characterize and valorize its marine biological resources and the by[products resulting from industry activity. Together with the Portuguese Hydrographic Institute it will provide support for activities in the field of the oceanography.	Planned		Global Challenge 2





ENERGGSYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	r EBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Pico r ave Power Plant	Pico Plant	WavEC Offshore Renewables	Pico plant is a shoreline Oscillating Water Colum eOWCf wave energy plant in 7m water depth, fully exposed to the North[westerly Atlantic swell of the Archipelago. It is a real environment test bench for OWC air turbines with pneumatic power available up to 700 kW, and about 50[100 kW during summer, which is a unique full[scale test scenario. The plant has been operating for several years but shows significant signs of structural damage; significant parts of the electrical and mechanical components needs to be replaced in order to serve as a research infrastructure.	Operating	www.pico[owc.net	Global Challenge 3
	Pico oermelho Geothermal Power Plant		EDA RENOVAVEIS, S.A.	Geothermal power plant located in S. Miguel island, Azores	Operating	www.edarenovaveis.eda.pt	Global Challenge 3
	Ribeira Grande Geothermal Power Plant		EDA RENOVAVEIS, S.A.	Geothermal power plant located in S. Miguel island, Azores	Operating	www.edarenovaveis.eda.pt	Global Challenge 3
	Ribeira Grande Hydroelectric Power Plant		EDA RENOVAVEIS, S.A.	Hydropower plant in Flores island, Azores	Planned	www.edarenovaveis.eda.pt	Global Challenge 3
	Al' m Fazenda Hydroelectric Power PlantPlant		EDA RENOVAVEIS, S.A.	Hydropower plant in Flores island, Azores	Planned	www.edarenovaveis.eda.pt	Global Challenge 3
	Flores PowerStore Flywheel Project		EDA, S.A.	The PowerStore is a compact and versatile flywheel[based grid stabilizing generator. Its main purpose is to stabilize power systems against fluctuations in frequency and voltage	Operating	http://www.energystorageexchange.org/projects/760	Global Challenge 3
	Graciosa PowerStore Flywheel Project		EDA, S.A.	The PowerStore is a compact and versatile flywheel[based grid stabilizing generator. Its main purpose is to stabilize power systems against fluctuations in frequency and voltage	Operating	http://www.energystorageexchange.org/projects/761	Global Challenge 3
	System of hybrid power Wind and solarf supported by an innovative baAery system		Graciolica, Lda	System of hybrid power ewind and solarf, supported by an innovative battery system, that will enable uninterrupted power supply, to be constructed in Graosa island, Azores	Operating and under construction	https://www.younicos.com/case[studies/graciosa	Global Challenge 3
	oulcanology e Seismicity monitoring infrastructures /e; uipment		University of Azores / CIVISA		Operating	http://www.cvarg.azores.gov.pt/civisa/Paginas/homeCIVISA.aspx	Global Challenge 3
	Portuguese r indscanner Facility	Windscanner. PT	University of Porto	The WindScanner facility is a laser[based wind measurement system that can generate detailed maps of wind conditions covering several square kilometres. The facility relies on innovative, remote[sensing, laser[based devices called lidars. WindScanner will be used by the wind energy industry to develop better and more durable turbines, and by the aviation industry to detect wind shear and turbulence along runways, making flying, and especially landing, safer	Under Construction	http://www.cvarg.azores.gov.pt/civisa/Paginas/homeCIVISA.aspx	Global Challenge 3





	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
ENERGY SYSTEMS THEMATIC AREA	National Research Infrastructure in Solar Energy Concentration	INIESC	University of Évora	INIESC is focused on thermal conversion of solar energy and aims at the development of solar energy concentration technologies. INIESC addresses different applications, ranging from water desalination or industrial process heat to thermoelectric production or solar fuels, promoting technology transfer to industry and enabling a holistic approach to the product development process. It looks into technology development as a process leading to marketable products and solutions.	Operating		Global Challenge 3
	Biomass and Bioenergy Research Infrastructure	BBRI	Laboratório Nacional de Energia e Geologia, I.P. (LNEG)				Global Challenge 3
	Research Infrastructure on Integration of Solar Energy Systems in Buildings	INEB-LAB	Laboratório Nacional de Energia e Geologia, I.P. (LNEG)				Global Challenge 3
	Smart grid and electric vehicle laboratory	SGEVL	Instituto de Engenharia de Sistemas e Computadores do Porto (INESC Porto)/FEUP				Global Challenge 3
	Collaboratory for Geosciences	C4G	University of Beira Interior	C4G is a distributed Research Infrastructure that shares equipment, data, collections and tools in Solid Earth Sciences (SESf). C4G comprises the disciplines of geology, hydrogeology, geochemistry, geodesy, geophysics, geomechanics and geomathematics, and provides services (see below) in the transversal areas of georesources, natural hazards and the environment, onshore and offshore. C4G collaborates at European level in the ESFRI project European Plate Observing System (EPoS) and it has been very active collaborating with African and South American Institutions. C4G offers access to a wide variety of services related to the Geosciences, including seismic data and networks, geophysical exploration, laboratories of rock physics and geomechanics, geodetic data and networks (including gravity data), geochemical and mineralogical laboratories, magnetic data and observatories, geological data and laboratories, geomathematics, remote sensing and paleomagnetism laboratories	Operating Under construction	http://www.c4g.pt.eu/	Global Challenge 3
DATA SCIENCE THEMATIC AREA	Portuguese National Distributed Computing Infrastructure	UC[LCA]	University of Coimbra	Provides advanced computing services. It includes (a) High Performance Computing (HPC) systems of a variety of architectures to enable larger simulations, analyses and faster computation times than are possible using computers available to individual researcher and (b) Data Storage/Archival systems to store data that result from performing simulations on HPC systems and (c) assistance to use these advanced computing resources effectively. UC[LCA] is the national node of PRACE (Partnership for Advanced Computing in Europe).	Operating	http://www.uc.pt/lca	Global Challenge 3





	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
DATA SCIENCE THEMATIC AREA	Portuguese National Distributed Computing Infrastructure	INCD	INCD Association	INCD is a research[devoted digital infrastructure that aims to provide computing and storage services to the national research and high[education communities from all fields of knowledge. Three INCD nodes are already underway, located in the North, Center and Lisbon regions. This modular approach supports expansion to other regions as the scientific community requires while infrastructure services are horizontal and independent of the physical nodes. Cloud services of IaaS, PaaS and SaaS are already planned, providing data analysis and advanced modeling tools for several areas, including ocean and coastal sciences.	Operating and Under Construction	http://www.incd.pt/	Enabling Activities 2
	Azores Government Data Infrastructure		Azores Regional Government [Directorate for Environment	It encompasses metadata, spatial data sets and services, network services and technologies, as well as agreements on the sharing and interoperability of the same geographic data, aims at solving some of the problems identified and creating common rules to ensure that Information and services are compatible with each other, in accordance with Directive 2007/2 / EC of the Parliament and of the Council of 14 March 2007 dNSPIREF, covering the connection and use of data and Services of other European programs.	Operating	http://www.ideia.azores.gov.pt/Paginas/Inicio.aspx	Enabling Activities 2

DATA SCIENCE THEMATIC AREA	Environmental Observatory of Azores	OAA	Associação Observatório do Ambiente; Azores Regional Government [Directorate for Science and Technology	Science communication in areas related to the environment	Operating	http://oaa.centrosciencia.azores.gov.pt/	Crosscutting activities: Knowledge for Space Space for Knowledge
	Portuguese Language expertise centre of the Office of Astronomy for Development of the International Astronomical Union	PLOAD	NUCLIO + IAGLR, Fci+ncias.IDf	Coordinated by NUCLIO in collaboration with the Institute of Astrophysics and Space Sciences. PLOAD is providing support to space[related outreach and educational [including higher education] activities in PALOP countries namely Brasil, Cabo Verde, São Tomé e Príncipe, Moçambique, with the final aim to implement IAU's strategic plan in portuguese speaking countries.	Operating		Crosscutting activities: Knowledge for Space Space for Knowledge
	Astronomic Observatory of Santana	OASA	Cooperativa da Ponte Norte; Azores Regional Government [Directorate for Science and Technology	Science communication in areas related to Space	Operating		Crosscutting activities: Knowledge for Space Space for Knowledge
	Azores Sea Observatory		Associação Observatório do Ambiente; Azores Regional Government [Directorate for Science and Technology	Science communication in areas related to the ocean	Operating	http://www.oma.pt/	Crosscutting activities: Promoting scientific literacy
	Copernicus academies and relays		European initiative	Copernicus academies and relays are a European initiative to leveraging user uptake of space applications and Copernicus, targeting University, Research, Private and Public actors, as well as Public Authorities. The EC is setting up a toolbox of user uptake measures, including a wide range of targeted initiatives such as supporting business creation through the Copernicus StartUps Program, supporting the internationalization of Earth observation companies, ensuring the most of EU financial instruments for Copernicus, setting up new financial tools [framework Partnership Agreement] to cofinance local initiatives in the Copernicus Participating Countries, or addressing the Earth observation skill gap through the development of dedicated educational programs and trainings.	Operating	http://www.oma.pt/	Crosscutting activities: Promoting scientific literacy





B • SPAIN – EXISTING INFRASTRUCTURES

SPACE SYSTEMS AND APPLICATIONS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	National Institute of Aerospace Technology "Esteban Terradas"	INTA	Direção Geral do Território; IPMA	A Public Research Agency specialised in Aerospace technological research and development, as well as covering R & D in the fields of land, naval and defense. Its main functions include: -Conducting all types of tests to check and certify materials, components, subsystems and application systems in their fields of activity; -Technical advice and the provision of services to official entities and agencies, as well as to industrial and technological companies; -The acting as technological center of the Ministry of Defense. As an example of an infrastructure: INTA Maspalomas Station, featuring a 15-metre antenna.	Operating	http://www.inta.es	Enabling Activities
	Center of Air Traffic Control of the Canary Islands	ACC	ENARE	The ACC, located next to the Gran Canaria airport, manages all Canary Island FIR traffic, except for the APP (APP - Tenerife Norte and Tenerife Sur) and the towers of control. Within this ACC is the inflow management position (PMP) which, in continuous contact with the data processing center and central inflow management unit (CFMU) in Brussels, is responsible for coordinating the transit flow of Arrivals and departures of the Canary Islands. In this way, the capacity of different sectors is not saturated and helps to maintain a safe and orderly flow of air traffic.	Operating	http://www.enare.es/cse/Satellite/navegacion_aerea/es/Page/1047382340145/	Enabling Activities 1
	Network of Permanent Stations of the Canary Islands		Cartographic of the Canary Islands (GRAFCAN)	17 GNSS stations - Global Navigation Satellite System	Operating	https://www.grafcan.es/red-de-estaciones	Enabling Activities 1
	Telde Observatory	OT	Institute of Astrophysics of the Canary Islands	The observatory was more than 20 telescope installations from institutes of all over the world, including solar telescopes. Its geographical location (between the eastern and western solar observatories), together with the clarity and excellent quality of the sky mean that the Observatory del Teide is ideally suited for studying the sun.	Operating	http://www.iac.es/eni.php?op1=3&lang=en	Enabling Activities 1





SPACE SYSTEMS AND APPLICATIONS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Center for Reception, Processing, Archiving and Dissemination of Earth Observation Datas	CREPAD Center	INTA	It provides users with easy access to Earth Observation and Atmosphere data and products, through the maintenance of infrastructures for the reception and processing of images coming from Earth Observation space missions, the systematic processing of parameters d.e., Sea Surface Temperature: Multi[Channel Sea Surface Temperature [MCSST and no Lineal Sea Surface Temperature [NLSST , normalized Difference Vegetation Index] NDVI, Marine Chlorophyll [Chlor_a; SST and Chlor_a temporal averages , NDVI maximum Value Composite, Aerosol Optical Thickness] AOT, Diffuse attenuation coefficient [Kd_490], the archiving and maintenance of all the processed data which can be available for end users, and the development of new applications that make use of the information coming from Earth Observation satellites	Operating	http://crepadweb.cea.inta.es/	Enabling Activities 1
	National Meteorological Agency	AEMET	Ministry of Agriculture, Food and Environment, Secretary of State for the Environment	Aims: the development, implementation and delivery of meteorological services within State scope in support of other public policies and private activities; contributing to the safety of people and goods and to the welfare and sustainable development of Spanish society.	Operating	http://www.aemet.es/es/portada	Enabling Activities 1
	Barcelona Expert Center	BEC		Provides support to the Spanish SMOS[related activities dsoil Moisture and Ocean Salinity: [provides assessment to ESA as a Level 2 Ocean Salinity Expert Support Laboratory [contributes to the SMOS instrument calibration and lower level algorithm developments [develops new algorithms for the generation of added[value products at Levels 3 and 4 [participates in validation activities [products under development: Salinity in marginal seas; Salinity in cold waters; Ocean currents; Sea ice concentration and thickness; Sea surface winds, convergence, and vorticity; Coastal and extreme winds; Ocean forcing; High[resolution soil moisture; Fire risk index	Operating	http://bec.icm.csic.es/	Enabling Activities 1
	Spanish National Earth Observation Satellite Programme Ingenio and Paz satellitesX			Spain is developing two EO Satellites named Ingenio and Paz, to be launched in 2017 and 2019: [Ingenio is a 2,5 m PAN/NIR satellite with a 55 km swath. [Paz is a 1m resolution X[band SAR satellite Both satellites have been designed for national applications including maritime surveillance and will also be integrated into the Copernicus initiative. They can be used for international cooperation.	Operating	http://bec.icm.csic.es/	Enabling Activities 1





SPACE SYSTEMS AND APPLICATIONS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Institute of Astrophysics of the Canary Islands	IAC		<p>International research center which comprises: [The Institute of Astrophysics, the headquarters, which is in La Laguna de Tenerife. [The Center of Astrophysics, La Palma de CALP [The Observatory del Teide de OTf, in Izaña de Tenerife.</p> <p>[The Observatory del Roque de los Muchachos de ORMf, in Garafía de La Palma. The exceptional quality of the sky over the Canaries for astronomical observations is protected by law. The IAC's Sky Quality Protection Office deOTPCf regulates the application of the law and its Sky Quality Group continuously monitors the parameters that define observing quality at the IAC Observatories.</p> <p>The IAC's research programme includes astrophysical research and technological development projects.</p> <p>The IAC is also involved in researcher training, university teaching and outreach activities.</p>	Operating	http://www.iac.es/	Enabling Activities
	Cartographic of the Canary Islands	GRAFCAN		<p>GRAFCAN facilitates the operations and institutionally performs the functions of the Canary Islands geographic institute.</p> <p>As an example, GRAFCAN was as product IDECanarias de Spatial Data Infrastructure of the Canary Islands with the objective of making the Canary Islands' geographic information available to all users through various servicesf</p>	Operating	https://www.grafcan.es/	Enabling Activities 1
	Observatory of Roque de los Muchachos	ORM	Institute of Astrophysics of the Canary Islands	<p>More than 15 telescopic installations from all over the world. Conditions at the Observatory are ideal not only for night time observations but also for Solar Physics. The Observatory also attracts researchers in High Energy Astrophysics.</p>	Operating	http://www.iac.es/en/observatory.php?op1=2&lang=en	Enabling Activities 1
	Gran Telescopio of Canary Islands	GRATECAN	Institute of Astrophysics of the Canary Islands	<p>largest and one of the most advanced optical and infra[red telescopes in the world. Its primary mirror consists of 36 individual hexagonal segments that together act as a single mirror. The light collecting mirror surface area of GTC is equivalent to that of a telescope with a 10.4m diameter single monolithic mirror. Thanks to its huge collecting area and advanced engineering the GTC classes amongst the best performing telescopes for astronomical research</p>	Operating and Under Construction	http://www.gtc.iac.es/	Enabling Activities 1
	Cherenkov Telescope Array S telescope North	CTA	CTA Observatory GmbH deCTAO GmbH	<p>Ground[based gamma[ray detector, with more than 100 telescopes located in the northern and southern hemispheres. Spain will participate in Las Palmas for the northern array site.</p>	Under Construction	https://www.cta-observatory.org/	Enabling Activities 1
	The Gravitational Wave Optical Transient Observer	GOTO	Astronomy and Astrophysics group at the University of Warwick. Located Roque de Los Muchachos observatory on La Palma..	<p>A project to identify optical counterparts to gravitational wave events. The GOTO project consists of a set of wide[field telescopes on a single mount, necessary to map the large source regions on the sky that accompany detections of gravitational waves with LIGO and VIRGO.</p>	Operating and Under Construction	https://goto-observatory.org/	Enabling Activities 1





SPACE SYSTEMS AND APPLICATIONS THEMATIC AREA

INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
Center for Reception, Processing, Archiving and Dissemination of Earth Observation Datas	CREPAD Center	INTA	It provides users with easy access to Earth Observation and Atmosphere data and products, through the maintenance of infrastructures for the reception and processing of images coming from Earth Observation space missions, the systematic processing of parameters d.e., Sea Surface Temperature: Multi[Channel Sea Surface Temperature [MCSST and no Lineal Sea Surface Temperature [NLSST , normalized Difference Vegetation Index] NDVI, Marine Chlorophyll [Chlor_a; SST and Chlor_a temporal averages , NDVI maximum Value Composite, Aerosol Optical Thickness] AOT, Diffuse attenuation coefficient [K _d 490], the archiving and maintenance of all the processed data which can be available for end users, and the development of new applications that make use of the information coming from Earth Observation satellites	Operating	http://crepadweb.cea.inta.es/	Enabling Activities 1
National Meteorological Agency	AEMET	Ministry of Agriculture, Food and Environment, Secretary of State for the Environment	Aims: the development, implementation and delivery of meteorological services within State scope in support of other public policies and private activities; contributing to the safety of people and goods and to the welfare and sustainable development of Spanish society.	Operating	http://www.aemet.es/es/portada	Enabling Activities 1
Barcelona Expert Center	BEC		Provides support to the Spanish SMOS[related activities of Soil Moisture and Ocean Salinity]: [provides assessment to ESA as a Level 2 Ocean Salinity Expert Support Laboratory [contributes to the SMOS instrument calibration and lower level algorithm developments [develops new algorithms for the generation of added value products at Levels 3 and 4 [participates in validation activities [products under development: Salinity in marginal seas; Salinity in cold waters; Ocean currents; Sea ice concentration and thickness; Sea surface winds, convergence, and vorticity; Coastal and extreme winds; Ocean forcing; High resolution soil moisture; Fire risk index	Operating	http://bec.icm.csic.es/	Enabling Activities 1
Spanish National Earth Observation Satellite Programme Ingenio and Paz satellites			Spain is developing two EO Satellites named Ingenio and Paz, to be launched in 2017 and 2019: [Ingenio is a 2,5 m PAN/NIR satellite with a 55 km swath. [Paz is a 1m resolution X-band SAR satellite Both satellites have been designed for national applications including maritime surveillance and will also be integrated into the Copernicus initiative. They can be used for international cooperation.	Operating	http://bec.icm.csic.es/	Enabling Activities 1





ATMOSPHERIC SCIENCE AND CLIMATE CHANGE THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	r EBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Center for assessment and management of air ; uality	CEGCAL	Owner: Azorean Biodiversity Group Funding Management: Fundação Gaspar Frutuoso	Ambient air quality controller in the Canary Islands, CEGCA. Must manage and provide the ambient air quality information according to the parameters regulated in the applicable regulations, as well as jointly manage the meteorological information related to the parameters of temperature, relative humidity, atmospheric pressure, precipitation, wind direction, Wind and global radiation. Centralize data from the various automatic stations, both public and private, scattered throughout the archipelago.	Operating	http://www.gobiernodecanarias.org/medioambiente/piac/temas/atmosfera/medidas[y]factores/calidad[del]aire/medidas[sobre]	Global Challenge 1
	Aerosol monitoring reference station of Pico de la Gorra			Monitoring Aerosols	Operating		Global Challenge 1
	Monitoring and control Network of air ; uality in the Canary Islands	RVCCAC	Dirección General de Salud Pública Comunidad Autónoma Canaria	Five fixed stations and one mobile automatic, that measure in continuous the quality of the air. All this information generated by the equipment installed in the stations is received in the control center, generating a database that is processed and analyzed daily, being able to signal in real time alarm situations.	Operating	http://www.gobierno.decanarias.org/medioambiente/calidaddeaire/inicio.do	Global Challenge 1
	Atmospheric observatory of Iza7a		Centro de Investigación Atmosférica de Iza7a CIAI	[Five offices available for researchers and technicians who visit; [A Observation Tower with 15 laboratories and a terrace of 150m2 with free horizon of obstacles where the radiation instruments and the different shots for air samples are located; [A laboratory for the calibration of radiometers, photometers and spectrometers horizontal, vertical and angular calibration; [An electronics workshop; [Two mechanics workshops; [A cylinder filling station with ambient air, identical to NOAA's in Niwot Ridge Colorado for the manufacture of standard gases worldwide.; [Two cisterns for storage of rain water with a capacity of 216m3 each; [A large installation of solar panels for heating and hot water.	Operating	http://izana.aemet.es/index.php?option=com_content&view=article&id=121&Itemid=136&lang=es	Global Challenge 1
	Aerosol reference station of Iza7a		Observatorio Atmosférico de Iza7a	Monitoring Aerosols Part of Aerosol Research Program of the Atmospheric Observatory of Iza7a, which is part of the World Metrological Organizations	Operating	http://izana.aemet.es/index.php?option=com_content&view=article&id=121&Itemid=136&lang=es	Global Challenge 1
	University Research Institute for Oceanography and Global Change Univ. Las Palmas de Gran CanariaX	IOCAG	Observatorio Atmosférico de Iza7a	IOCAG arises to structure and coordinate a number of consolidated and interdisciplinary research groups at the University of Las Palmas de Gran Canaria, and it is intended to assess the ocean's role in the Climate Change, while investigating how this change affects the planet in the singular marine and coastal ecosystems. It comprises the following facilities: [Oceanography instruments and analysis [Environment and remote sensing [Spanish Bank of Algae BBAF	Operating	http://iocag.ulpgc.es/	Global Challenge 1
	University Research Institute of Bioorganic Antonio González	IUBO[AG		IUBO[AG is a multidisciplinary research center oriented to the investigation of Bioactive Natural Products. It aims to isolate pharmacologically active substances from natural sources, biosynthesis, microorganism cultures, biotechnology and total synthesis. In addition biological evaluation, toxin isolation and production, NMR studies of biological process, natural insecticide and repellents, etc. are research areas of current interest.	Operating	https://www.ull.es/view/institutos/iubo/Inicio/es	Global Challenge 1





OCEAN SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Oceanic Platform of the Canary Islands	PLOCAN		<p>PLOCAN is a multipurpose technical/scientific service infrastructure that provides support for research, technological development and innovation in the marine and maritime sectors, available to public and private users. PLOCAN offers both onshore and offshore experimental facilities and laboratories, operational throughout the whole year thanks to the Canary Islands excellent climatic conditions.</p> <p>PLOCAN provides:</p> <ul style="list-style-type: none"> [An ocean observatory for the continuous and real-time monitoring in fields such as the study of global change and ocean acidification, water column and deep-sea ecosystems, ocean biogeochemistry and geophysics. [A test bed for the research, demonstration and operation of marine technologies, especially those related to marine renewable energy. [A base for underwater vehicles: it owns a series of underwater unmanned state-of-the-art technologies such as gliders, ROVs and AUVs; it supports missions deploying customers' vehicles. [A training platform for institutions and enterprises. [An innovation hub offering efficient and high quality R&D&I project management services. 	Operational	http://www.plocan.eu/index.php/en/	Global Challenge 1 Global Challenge 2 Global Challenge 3
	Multi-instrumented permanent deep-sea observatories ESTOC S EMSO	ESTOC] EMSO		European Station for Time series in the Ocean Canary islands ESTOCf is a multi-instrumented permanent deep-sea observatory located at a depth of 3600 m, initiated with the main objective of contributing to the ocean observation international programs. It is presently the oceanic observation node of the PLOCAN and EMSO.	Operational	http://observatorios.plocan.eu/index.php/en/description	Global Challenge 2
	University Research Institute in Sustainable Aquaculture and Marine Ecosystems W Univ. Las Palmas de Gran CanariaX	IU[ECOAE UA		IU[ECOAE UA aims to contribute to the economic development of the Canaries through the generation of knowledge on conservation and sustainable use of the different resources, including coastal resources and aquaculture, and their transfer to society, allowing the construction of new business opportunities. It is a platform on platform on Sustainable Aquaculture under an Ecosystem Approach.	Operational	http://ecoaqua.ulpgc.es/IU[ECOAE UA	Global Challenge 2
	University Research Institute for Environmental Studies and Natural Resources W Univ. Las Palmas de Gran CanariaX	i[UNAT		i[UNAT focused in integrating research from different disciplines to generate studies related to the environment and natural resources, as well as the implementation of new measures suitable for sustainable environmental development and the optimal conservation, use and management of natural resources. It contributes effectively and energetically to research, innovation and the development and sustainable growth of the Canary Islands.	Operating	http://www.iunat.ulpgc.es/iunat/home	Global Challenge 2





OCEAN SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Spanish Bank of Algae Univ. Las Palmas de Gran Canaria	BEA		<p>The Spanish Bank of Algae, is a national R & D + i of the University of Las Palmas de Gran Canaria linked to its Scientific and Technology Park ePCTf whose basic objectives isolation , identification, characterization, conservation and supply of microalgae and cyanobacteria. Besides these features, BEA is intended as a service to facilitate the development of a new sector based bioindustrial cultivation and application of microalgae and cyanobacteria.</p> <p>Some services: A. Strain identification by microscopy; B. Strain identification by DNA analysis; C. gDNA i " la cartei; D. Strain isolation and purification; E. Patent depository; F. Deposit for maintenance; G. Flow Cytometry; H. International Courses; I. Acceptance of strain donations.</p> <p>Some products: A. Strains eMain catalog, Axenic strains, gDNA Strains, Sequenced DNA strains; B. g[Strains i easy]to[growi ; C. Genomic DNA; D. Culture media and seawater</p>	Operating	http://www.marinebiotechnology.org/en/	Global Challenge 2 Global Challenge 3
	Macaronesian Marine and Maritime Network	R3M		<p>The Macaronesian Marine and Maritime Network is an initiative including Azores islands, Madeira Islands, Cape Verde islands and Canary islandsf aimed at increasing the quantity and quality of marine environment observation, in order to understand and predict both the phenomena that take place in it and the environmental and socioeconomic impacts these may entail. The initiative is essentially inclusive and its main goal is to make all the observations carried out in the Macaronesian marine environment compatible and accessible. The integration spreads over the instrumental approach, because the aim is to add and make available the historical observations of different plaEorms in the Macaronesian area, "in[situ]" observations from both moored and drifting devices, on surface or undulate through the water column, and remote sensing carried out by satellite.</p>	Operating	http://r3m.estramar.eu/index.php/en/	Global Challenge 1 Global Challenge 2
	Instituto de Productos Naturales y Agrobiología	IPNA		<p>IPNA's objectives are varied taking into account that it is a multidisciplinary center and its activities are framed in three Research Areas:</p> <ul style="list-style-type: none"> [Chemical Sciences and Technologies [Agricultural Sciences [Natural resources 	Operating	https://www.ipna.csic.es/	Global Challenge 2
	Granadilla Environmental Observatory	OAG		<p>OAG aims to collaborate with the departments and institutions of the Autonomous Community of the Canary Islands and other Macaronesian archipelagos as well as with the institutions of the State Administration, with competence in the conservation of the marine environment, and with the entities of Scientific or conservationist nature linked to the marine environment. It comprises:</p> <ul style="list-style-type: none"> [Environmental monitoring activities [Activities including the evaluation of the conservation status of species and habitats included in the European Habitat Directive; [Marine data repository activities, including storage, integration and custody of marine data, with a view to the maximum possible exploitation of the data see belowf [Ocean literacy activities 	Operating	http://www.oagfundacion.org/	Global Challenge 2





OCEAN SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Canary Islands Marine Integrated Data Repository	REDMIC		REDMIC is an integrated marine data repository following the Open Data philosophy. It has been designed for the Canary Islands and, by extension, Macaronesia.	Operating	http://www.oagfundacion.org/index.php/redmic/redmic/introduccion	Global Challenge 2
	Environmental Hydraulics Institute of Cantabria	IHC		Is a joint research center that carries out research, knowledge transfer and training of specialists in the fields of fresh and saltwater. It has several infrastructures of interest to the Atlantic Interactions: Ocean science: [Wave Basins: Directional Wave Tank [TÓDf, Cantabria Coastal and Ocean Basin [COB; water tank of deep water [Wave and Current Flumes: Wave[Current [Tsunami Flume [COCOTsuf, Wave[Current Flume [COCf, Channel Variable Slope [CPVf [Hypersaline Tank [TESEO: Oil spill modelling [Coastal Modeling System [Meteorcean data [wind, wave, currents and sea level Climate Change: [C3sim Renewable Energies: [Floating infrastructures [Fixed infrastructures	Operating	http://www.ihcantabria.com/en/	Global Challenge 1 Global Challenge 2 Global Challenge 3
	Spanish Institute of Oceanography	IEO		IEO conducts basic and applied research and provides scientific and technological advice to administrations in matters related to oceanography and marine sciences. It has centers distributed all over Spain. Several research infrastructures can be relevant to the Atlantic Interactions initiative: [Satellite data Reception Station at Santander [Distributed Data Center on Oceanographic Data [Experimental Plants on Aquaculture and Sea farming [Canary Islands, Vigo, El Boal, and Mazarrón [Research vessels [see below and ROV LIROPUS 2000	Operating	http://www.ieo.es/web/ieo/acerca	Global Challenge 2
	Research vessels MCTS FLOTAX	IEO and CSIC		An infrastructure shared by the Spanish Institute of Oceanography [IEO and the Spanish Research Council [CSIC to manage a research fleet encompassing 10 oceanographic vessels: [Hesperides [Sarmiento de Gamboa [García del Cid [Ramón Margalef [I ngeles Alariño [Mytilus [Francisco de Paula Navarro [José María Navaz [Lura [SOCIB	Operating		Global Challenge 1 Global Challenge 2





OCEAN SGSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	r EBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Antarctic Research Stations	IEO and CSICC		An infrastructure shared by the Spanish Institute of Oceanography dEOf and the Spanish Research Council dCSICf to manage the Antarctic Research Stations: [Juan Carlos I Spanish Research Station [Gabriel de Castilla Spanish Research Station	Operating	http://www.csic.es/grandesinstalaciones	Global Challenge 1 Global Challenge 2
	CSIC Ocean Research Infrastructures	CSIC		CSIC Ocean research infrastructures include: [Technological Marine Unit dVigo and Barcelonaf [Satellite ocean[colour products dC@dizf [Gibraltar Fixed Time Series dStrait of Gibraltarf [OVIDE Repeated Section dPortugal[Greenlandf [Observations[model coupling dC@dizf [Integrated CO2 and non CO2 greenhouse gases observing system dC@dizf and Vigof [Improving knowledge on and management of EU Fisheries outside Europe dC@dizf	Operating		Global Challenge 1 Global Challenge 2
	El Pardo Hydrodynamics Experimental Channel	CEHIPAR		Is a public and independent, internationally recognized hydrodynamic center for model tests, projects and research. It is a service and consulting company for customers from the administration and the industry, such as shipyards, engineering offices, manufacturers, ship[owners, research centers, as well as from sports associations, and individuals:	Operating	http://www.cehipar.es/index.php?lang=english	Global Challenge 3

ENERGG SGSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	r EBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Technological Institute of the Canary Islands	ITC		The competences of the ITC are framed in the fields of Research, Development and Innovation at a regional level, with the aim to fostering technological advancement to improve the quality of life. The ITC supports Islands integral development through the implementation of practices and the deployment of projects related to R&D&i. It also encourages and promotes technological innovation in local businesses and boost an economy based on knowledge and built on the capabilities of existing research and technological developments in the Canaries. One of the areas where it develops services is in the energy area, including studies about the stability of islands electric networks.	Operating	http://www.itccanarias.org/web/	Global Challenge 3
	PLOCAN test site for renewable ocean energy	PLOCAN		A Offshore PlaEorm for the research, demonstration and operation of marine technologies, especially those related to marine renewable energy, with capacity to validate development of offshore wind, wave and tidal converters.	Operating		Global Challenge 3





ENERGY SYSTEMS THEMATIC AREA	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
	Technological Institute of Renewable Energy	ITER		ITER was established with the aim of supporting sustainable development and innovation on the island of Tenerife. Today, ITER stands as an international centre of reference for research into renewable energies, engineering, telecommunications and the environment. Two of its main goals are: • To extend the use of renewable energies on the island of Tenerife and • To provide the region with cutting-edge R&D+i infrastructure. Among its facilities and technical resources one can find: [Photovoltaics Laboratory, known as SiCell Lab [Several meteorological stations for the measure of meteorological parameters such as wind, solar radiation, humidity and temperature [Photovoltaic installations [Photovoltaic modules factory [Wind parks [Generation Control Centre of the Institute of Technology and Renewable Energies eCCG ITERf [Wind tunnel	Operating	http://www.iter.es/	Global Challenge 3
	Centro demostrador de hidroenergía de Gorona del viento			The hydroelectric project includes a wind farm, a pumping group and a hydroelectric plant. The wind farm is capable of supplying electricity directly to the grid and, simultaneously, feeding a pumping group that holds water in a raised tank, as an energy storage system. The hydroelectric power plant harnesses the stored potential energy, guaranteeing the electrical supply and the stability of the network. The wind farm realizes the capture and transformation of wind energy into electrical energy. The hydraulic system running as a pump, makes of accumulator of energy surplus; Operating as a generator, acts as producer of electric power and regulator of the electrical system on the island.	Operating	http://www.goronadelviento.es/index.php?accion=articulosseccion&IdSeccion=73	Global Challenge 3
	Solar Research Platform at Almería	PSA	CIEMAT	It is the largest concentrating solar technologies development and test center in Europe. It encompasses: [Concentrating Solar Technologies: Medium and High, Solar fuel and industrial processes at high temperature, and thermal storage [Solar desalination technologies [Solar water treatment unit	Operating	http://www.psa.es/en/	Global Challenge 3
	CIEMAT Testing Laboratory for power takeoff devices		CIEMAT	Testing laboratory for power takeoff devices at the Research Centre for Energy, Environment and Technology eCIEMATf.	Operating	http://www.ciemat.es/	Global Challenge 3
	Biscay Marine Energy Platform	bimep		bimep is an open-sea facility to support research, technical testing and commercial demonstration of pre-commercial prototype utility-scale floating Marine Renewable Energy Devices. BiMEP provides manufacturers of such devices with ready-to-use facilities to validate their designs and to test their technical and economic feasibility. bimep occupies a 5.3 km ² marked area excluded for navigation and maritime traffic, and located at a minimum distance of 1,700 m from shore, close enough for fast access to deployed devices. The water depth in this area ranges from 50 to 90 m. The total power of 20 MW is distributed over four offshore connection points of 5 MW each.	Operating	http://bimep.com/en	Global Challenge 3





	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
DATA SCIENCE THEMATIC AREA	University Institute of Intelligent Systems and Numeric Applications in Engineering Univ. Las Palmas de Gran Canaria	SIANI	INCD Association	The Institute of Intelligent Systems and Numerical Applications in Engineering (SIANI) owns several research laboratories and teaching classrooms that permit the development of new technologies. It includes a Data Processing Centre (CPDf).	Operating	http://www.siani.es/en/home.html	Enabling Activities 2
	Spanish Supercomputing Network	IDeTIC	INCD Association	IDeTIC laboratories are provided with material for the design, development, implementation, construction and testing of communications systems and signal processing applications ranging from low frequency communication systems up to 40GHz, identification systems based on biological characteristics, communications systems based on infrared or visible light, sensor networks, etc. Some services related to the Atlantic Interactions Initiative are: [Development of comprehensive control systems and data acquisition; [Design, development and assembly of radar systems	Operating	http://www.siani.es/en/home.html	Crosscutting activities: Addressing technology transfer
DATA SCIENCE THEMATIC AREA	Technological Centre for Innovation in Communications Univ. Las Palmas de Gran Canaria	IDeTIC		IDeTIC laboratories are provided with material for the design, development, implementation, construction and testing of communications systems and signal processing applications ranging from low frequency communication systems up to 40GHz, identification systems based on biological characteristics, communications systems based on infrared or visible light, sensor networks, etc. Some services related to the Atlantic Interactions Initiative are: [Development of comprehensive control systems and data acquisition; [Design, development and assembly of radar systems	Operating	http://www.idetic.ulpgc.es/idetic/index.php/en/	Crosscutting activities: Addressing technology transfer

Data Management by domain Spanish Supercomputing Network led by the Barcelona Supercomputing Center (BSC)

	INFRASTRUCTURES AND NETWORKS	ACTIVITIES	ADDITIONAL RESOURCES
SPACE SYSTEMS AND APPLICATIONS			
ATMOSPHERIC SCIENCE AND CLIMATE CHANGE	<ul style="list-style-type: none"> EC(Earth Earth system model SDS(WAS and BDFC dust centres in collaboration with AEMET and WMOF 	<ul style="list-style-type: none"> Contributions to the sixth coupled model intercomparison project (CMIP6) Participation in the World Weather Research Programme and World Climate Research Programme Contributions to the Copernicus programme Scientific and technical contribution to the EC(Earth consortium Use of air quality and climate information as a support for public policy and decision making processes Pollutant transport at urban scale Coupling of atmospheric models and urban scale models Volcanic ash forecast and impact on civil aviation Volcanic hazard assessment 	<ul style="list-style-type: none"> Data portal for the dissemination of climate simulations (ESGF node) Modelling of cross[boundary pollutant transport Discovery and simulation in climate research through modelling and data analysis Air quality and climate service development based on multiple internal and external data sources Development of a capability to model and predict global carbon fluxes Assistance for the use of high[end IT solutions in environmental data analysis and modelling Online service Nowcasting of urban scale winds and air quality



	INFRASTRUCTURES AND NETWORKS	ACTIVITIES	ADDITIONAL RESOURCES
SPACE SYSTEMS AND APPLICATIONS			
OCEAN SCIENCE AND TECHNOLOGY	<ul style="list-style-type: none">• NEMO ocean community model	<ul style="list-style-type: none">• Scientific and technical contribution to the NEMO ocean community model development	<ul style="list-style-type: none">• Sea[ice modelling and forecasting• Ocean net primary production modelling and forecasting• Evaluation of disaster scenarios in ocean evolution
ENERGY SYSTEMS	<ul style="list-style-type: none">• Marenostrum4 supercomputer• EUROfusion	<ul style="list-style-type: none">• Scientific and technical contribution to the NEMO ocean community model development• Development of HPC simulation tools for multi[physics problems• Applications in wind, fusion and marine energies• High resolution wind modelling• Wind resource assessment• Development of geophysical exploration tools for geothermal energy	<ul style="list-style-type: none">• Assessment of the impact of dust exports on solar energy generation• A HPC simulation tool for multi[physics problems
DATA SCIENCE		<ul style="list-style-type: none">• Development of a solution to incorporate real[time ship emission data in urban emission models for air quality forecasting• Deep learning for automatic operation of energy systems• Real time analytics and visualization of large volumes of streaming sensor data.	

C • BRAZIL

To be completed and rearranged in a similar table to the one for Portugal and Spain after receiving the national information in the matrix file sent

The workshop held in Brazil allowed the identification of synergies that fully exemplify the type of cooperation that can be established through the AIR Center, combining national research priorities and the research opportunities presented by international interdisciplinary cooperation for attaining better and more comprehensive datasets for innovative research (Table 3).

SYNERGIES WITH BRAZIL			
SPACE SCIENCE AND TECHNOLOGY	Satellite launch and operation	Satellite data collection and processing	Interoperability between different computational systems
ATMOSPHERIC SCIENCE	Cloud formation identification mechanisms and modeling	Monitoring of the atmospheric transport of pollutants emitted in the South American and South African continents	
OCEAN SCIENCE AND TECHNOLOGY	Ocean and ocean-atmosphere interaction monitoring programs	Satellite based Oceanography	Ocean technologies and renewable energy
CLIMATE CHANGE	Biogeochemical variability at the tropics and CO ₂ flows quantification	Global climate change models development and calibration	Climate change scenarios analysis: Project PNUD and Project PROBIO
ENERGY SYSTEMS	Data sets to model and design sustainable energy systems: Project SONDA; Project SWERA	Wind forecasting: Project PREVENTO	Public disclosure of renewable energy availability data

Table 3 – Potential Synergies of the Atlantic Research Center with Brazil

In addition, the development of a cooperative agenda between the AIR Center and INPE for capacity building of young undergraduate and graduate students is an imperative for a long-term perspective of scientific and technological aspirations of tackling global issues in areas of space and oceans. Moreover, the possibility of applying technology transfer mechanisms, as foreseen by the IOC Criteria and Guidelines on Transfer of Marine Technology, would be key to enhance cooperation North to South.

After the meeting in Brazil specific points of cooperation with the State of Ceará were also identified (Table 4):

AREA OF COOPERATION	OBJECTIVE	ORGANIZATION
OCEAN SCIENCE AND TECHNOLOGY	Understanding and determination of impacts suffered by the Oceans and coastal areas as a consequence of economic exploitation of renewable and non-renewable resources.	UFCE, LABOMAR, UECE
CLIMATE CHANGE	Use of climate information as a support for public policy and decision making processes for Ceará economic sectors of interest such as agriculture, industry, environment and energy	FUNCEME, UECE e UFCE
ENERGY SYSTEMS	Development of technologies of energetic efficiency	IFCE, UNILAB, SINDENERGIA, SECITECE e SEBRAE
DATA SCIENCE	Development of a platform for Ocean monitoring (internet of things) development of specific sensors interconnected used for identification and prediction of phenomena	IFCE, ITIC, UFCE, SDBF, UECE, NPTECF, CTI[Ne] UFCE, SDBF; CTI[Ne]; UECE, NPTECF, ITIC
DATA SCIENCE	Development of sensors for space applications	CTI[Ne], ITIC, UECE, IFCE

Table 4 – Potential Synergies of the Atlantic Research Center with Brazilian State of Ceará



F O T O G R A F I A

FOTOS AeORES E LISBOA: **LURSA FERREIRA**

FOTOS INDIA: **CLARA AZEVEDO**



D • EUROPEAN LEVEL – EXISTING INFRASTRUCTURES

To be completed

	INFRASTRUCTURE NAME	SHORT NAME	MANAGING ORGANISATION	SHORT DESCRIPTION	STATUS	WEBPAGE	CONTRIBUTION TO THE ATLANTIC INTERACTIONS AGENDA
CROSSCUTTING ACTIVITIES	Copernicus academies and relaye		European Comission	Copernicus academies and relaye are a European initiative to leveraging user uptake of space applications and Copernicus, targeting University, Research, Private and Public actors, as well as Public Authorities. The EC is setting up a toolbox of user uptake measures, including a wide range of targeted initiatives such as supporting business creation through the Copernicus Start-up Program, supporting the internationalisation of Earth observation companies, ensuring the most of EU financial instruments for Copernicus, setting up new financial tools (Framework Partnership Agreement) to co-finance local initiatives in the Copernicus Participating Countries, or addressing the Earth observation skill gap through the development of dedicated educational programs and trainings.	Operating	http://copernicus.eu/news/copernicus-academy-network-comerstone-build-skills-sustainability-growth-and-jobs	Crosscutting activities: Knowledge for Space – Space for Knowledge