Satellite Technologies for Sustainable Urban Development

The EO Lab Experience

From Use-case To Community Support

AIR CENTRE

ATLANTIC INTERNATIONAL RESEARCH CENTRE

26th CSTD

Geneva, 27-31 March 2023

João Pinelo

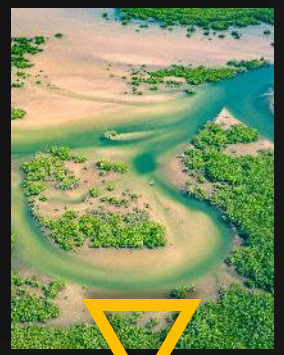
Head of Data Science, Cloud Infrastructure and Development

26th Commission on Science and Technology for Development

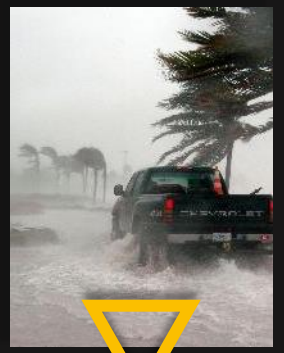
Outline

- Overview of the AIR Centre
- Earth Observation Lab
- Applied Science (digitalisation, data science, data-based reporting and applications and capacity building)

AIR CENTRE OVERVIEW
Charter: Thematic Missions and Vision

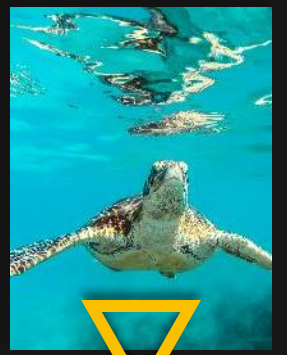


Clean and productive bays and estuaries

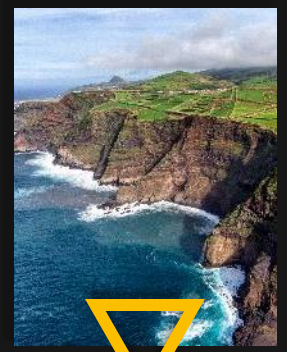


Resilience to coastal natural hazards

Sustainable food production



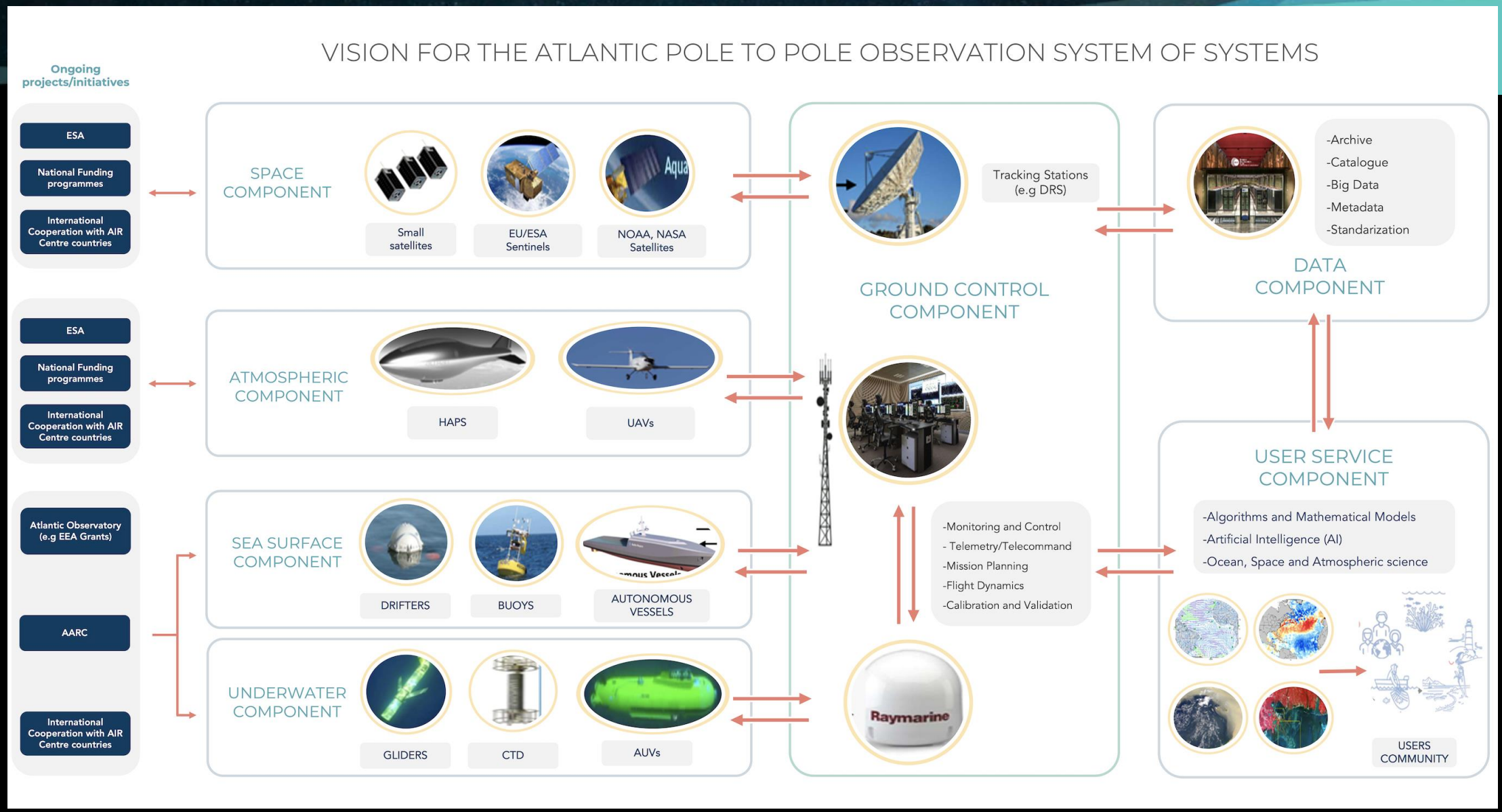
Improved management of marine and coastal resources



Improved environmental and maritime monitoring

- To serve the scientific community
- Job creation and knowledge-driven economic development
- To monitor and contribute to reaching the UN Sustainable Development Goals

Atlantic Pole-to-Pole System of Systems (APPOS)



EVOLUTION OF THE AIR CENTRE 2018-2022

High-level Dialogues – international leaders and stakeholders

Main Indicators

+500 PARTNERS

~80 SUBMITED PROPOSALS

APPROVED PROJECTS 39

KEY COUNTRIES 21

85 MAIN INSTITUTIONS

EVENTS 293

AIR CENTRE
ATLANTIC INTERNATIONAL RESEARCH CENTRE

MISSIONS 5

+120

PHD APPLICATIONS

The AIR Centre Network in the Atlantic 2022, key highlights

SUMMARY STATISTICS 21-22

In 2022:

- 10 MoUs signed (Kenya, Portugal, Brasil (Macapá), Colômbia (Bogotá), Maldives, Cabo Verde, Ghana, Guatemala);
- More than 20 international events in Atlantic regions;
- 17 Networking Fridays with the international scientific community;

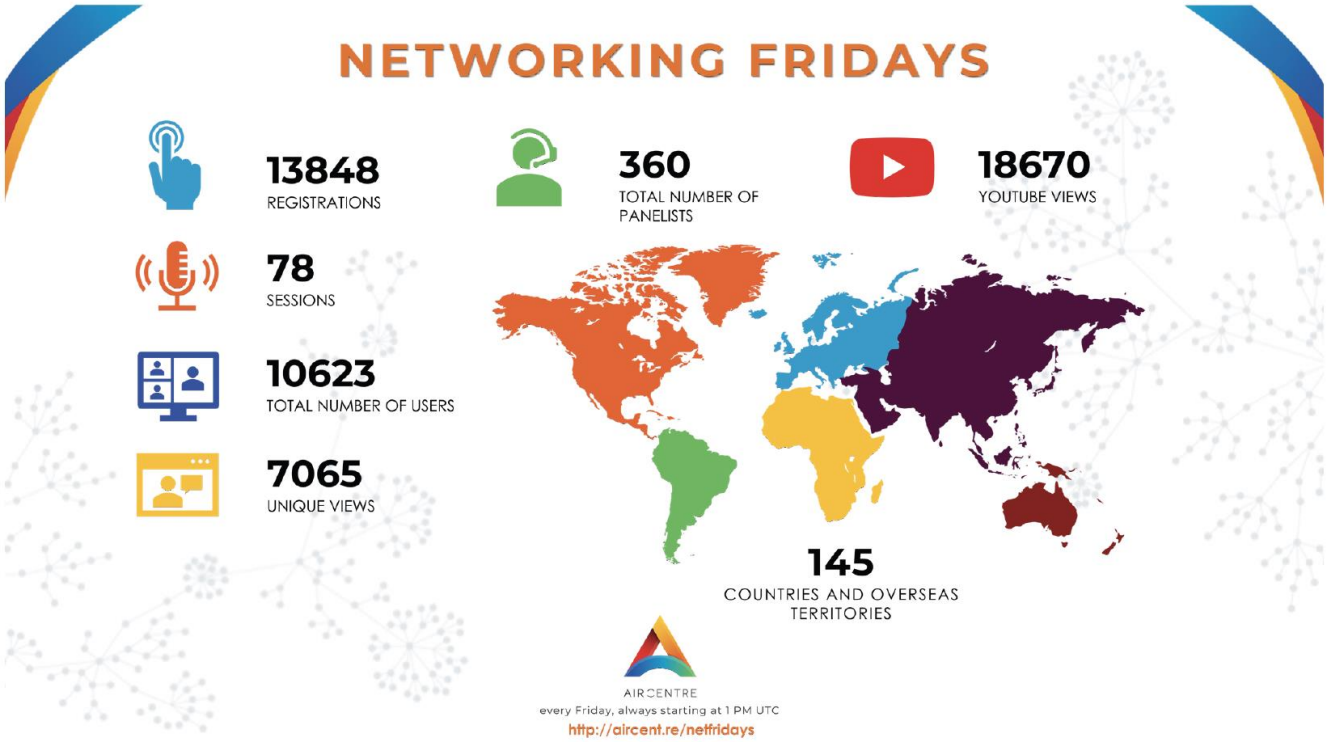


Figure 3 - Networking Fridays statistics until 2022

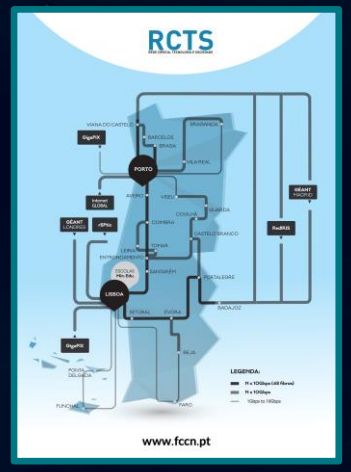
AIR CENTRE OVERVIEW
International Colaboration Networks

AIR CENTRE

Headquarters – Terinov, Terceira Island
Earth Observation Laboratory
Marine Biodiversity Observation Network

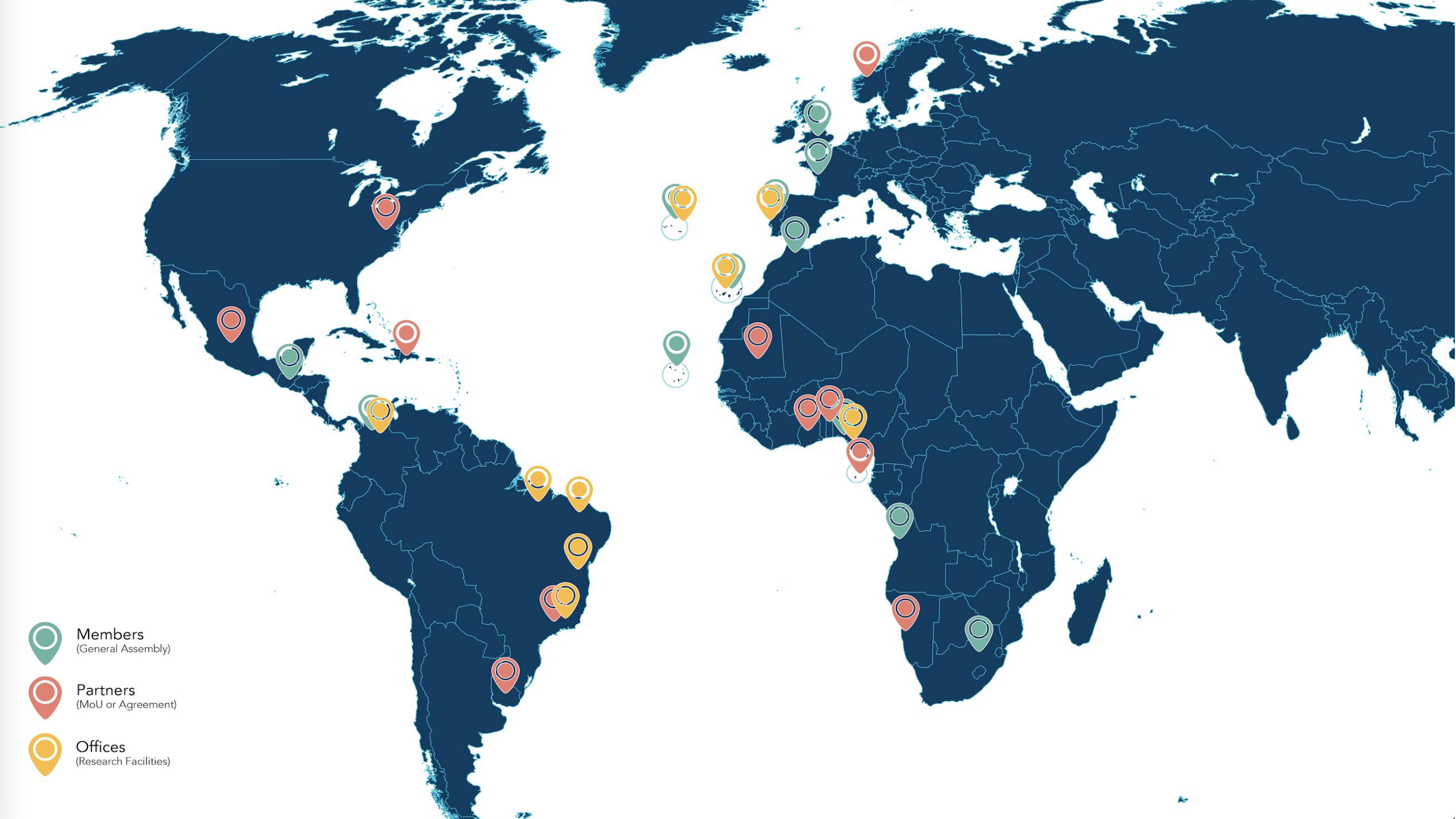
UK
NORWAY
USA
PORTUGAL
FRANCE
SPAIN
MORROCO
MEXICO
GHANA
NIGERIA
CAPE VERDE
COLOMBIA
S. TOMÉ AND PRÍNCIPE
BRAZIL
ANGOLA
NAMÍBIA
SOUTH AFRICA

Géant



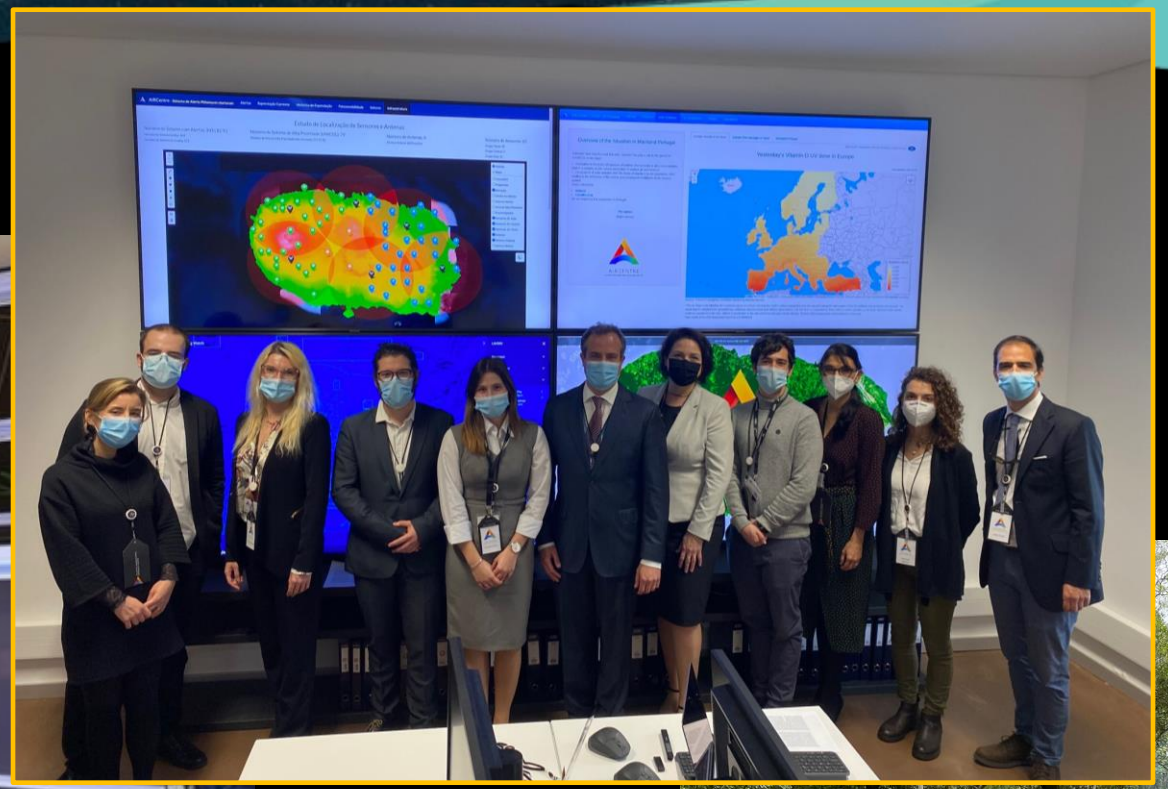
MBON
Marine Biodiversity Observation Network

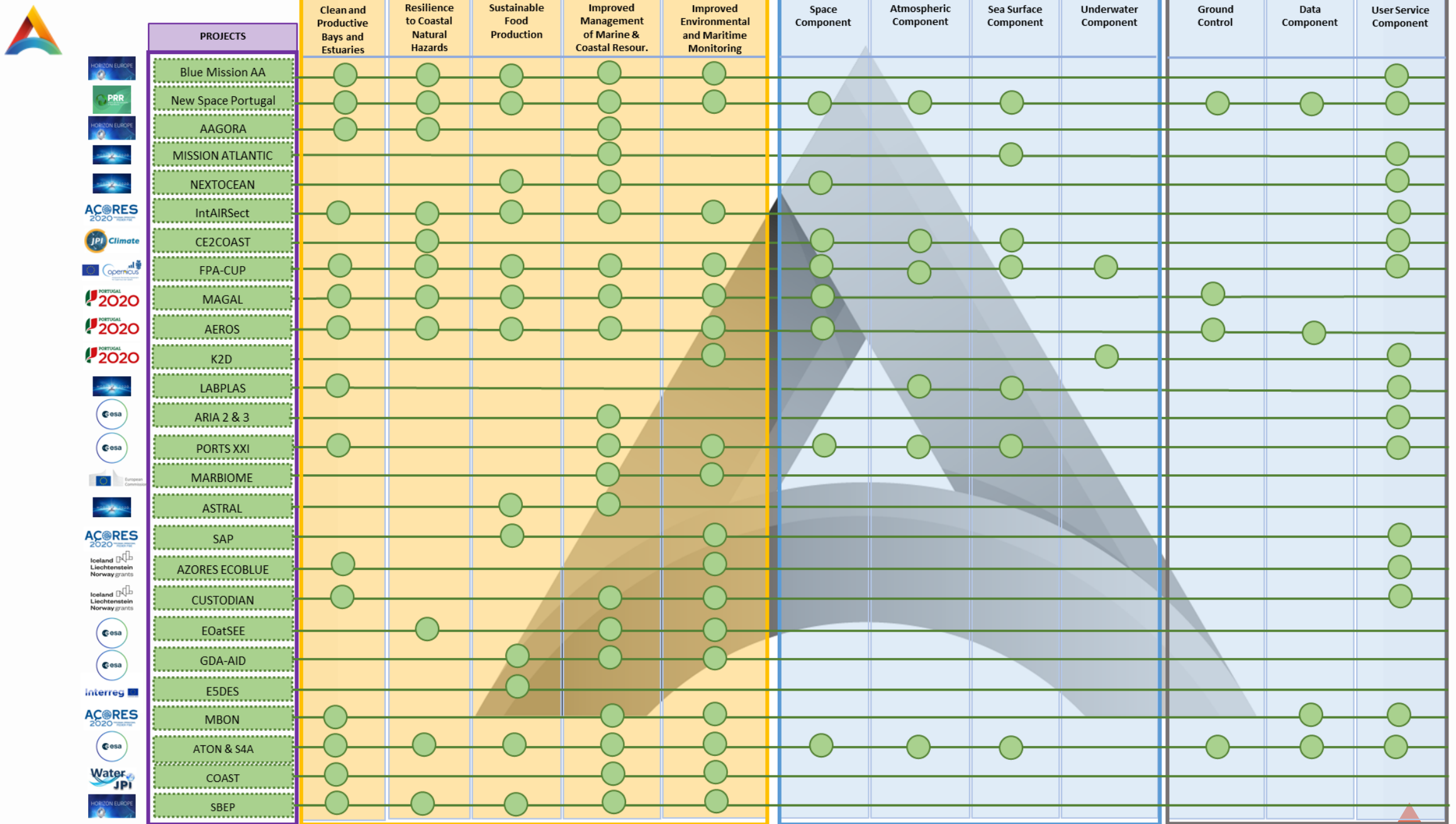
UN environment programme
50
1972-2022


Members
(General Assembly)
Partners
(MoU or Agreement)
Offices
(Research Facilities)

AIR CENTRE OVERVIEW

Earth Observation Laboratory (Azores)




AIR Centre's Missions
Observation Segment
Control, Data and Service Segment
PROJECTS
Clean and Productive Bays and Estuaries
Resilience to Coastal Natural Hazards
Sustainable Food Production
Improved Management of Marine & Coastal Resour.
Improved Environmental and Maritime Monitoring
Space Component
Atmospheric Component
Sea Surface Component
Underwater Component
Ground Control
Data Component
User Service Component
Blue Mission AA
New Space Portugal
AAGORA
MISSION ATLANTIC
NEXTOCEAN
IntAIRSect
CE2COAST
FPA-CUP
MAGAL
AEROS
K2D
LABPLAS
ARIA 2 & 3
PORTS XXI
MARBIOME
ASTRAL
SAP
AZORES ECOBLUE
CUSTODIAN
EOatSEE
GDA-AID
E5DES
MBON
ATON & S4A
COAST
SBEP

Earth Observation Lab
Leveraging on Coordination and Support Actions

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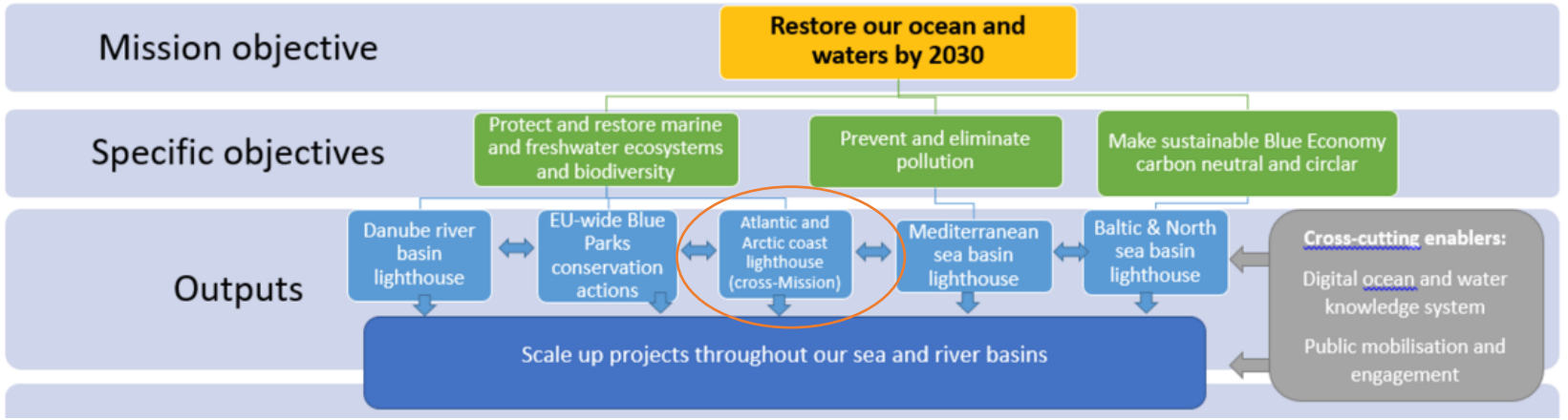
BLUEMISSION AA

Building a coordination hub to support the mission implementation in the Atlantic and Arctic Basins

BlueMissionAA coordination hub to support implementation of the EU Mission Restore our Ocean and Waters by 2030 in the Atlantic & Arctic basins. Restoration of marine and coastal ecosystems and increased climate resilience. Consolidate and mobilise a wide community of relevant stakeholders and EU citizens towards the achievement of Mission objectives at basin level. Deliver an effective governance framework, build a well-coordinated monitoring framework, provide supporting services, foster an attractive innovation ecosystem for ecological restoration.



AIR CENTRE · Foras na Mara Marine Institute · MaREI Energy · Climate · Marine · FRCT Fundo Regional para a Ciência e Tecnologia · ICES International Council for the Exploration of the Sea · CIEM Conseil International pour l'Exploration de la Mer

PLOCAN Plataforma Oceánica de Canarias · NIVA Norsk institutt for vannforskning · Ifremer · IPMA

CPMR CRPM Conference of Peripheral Maritime Regions · Fraunhofer

AWI · spi Sociedade Portuguesa de Inovação · Consiglio Nazionale delle Ricerche · SDU Syddansk Universitet · UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

Earth Observation Lab
Key Projects

EOatSEE - exploit EO technology complemented by models and in-situ observations, to improve our understanding of how extreme sea level events happen, and how we can protect coastal areas from them. Bring EO Experimental oroducts closer to meaningful societal applications in support of knowledge-based decision making

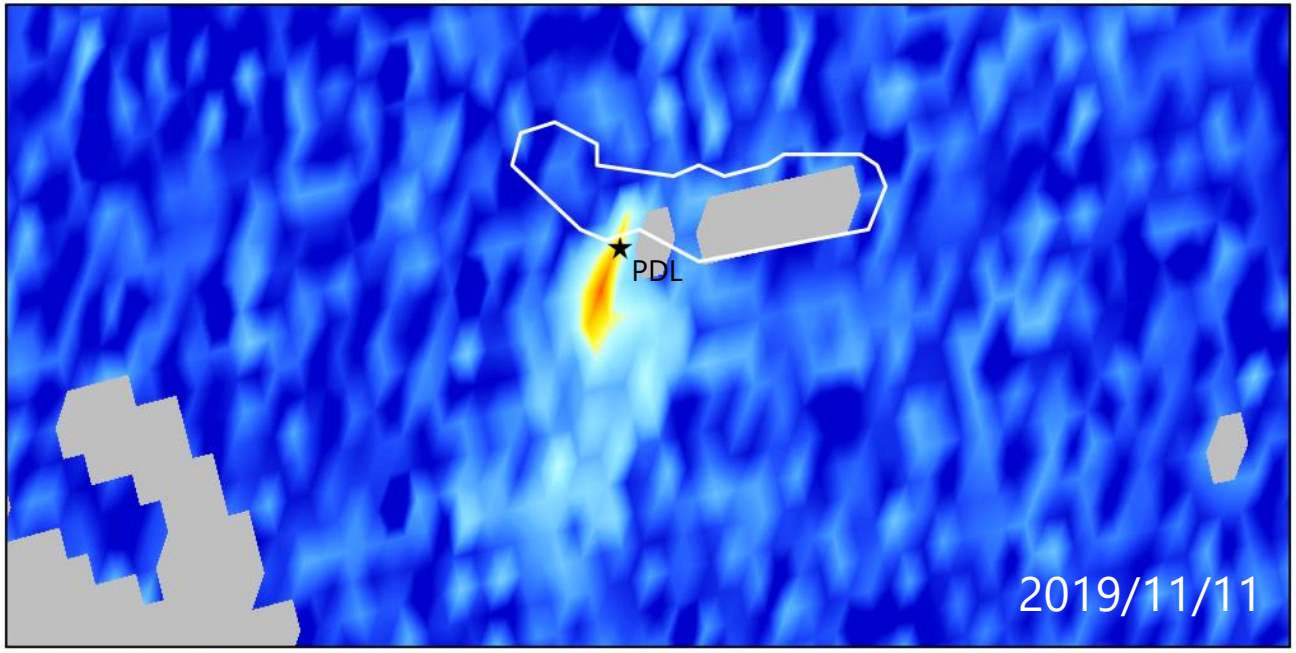
Atlantic Regional Initiative 2 and 3: Development and delivery of EO-based services to i) support wind energy sector in the design and operations planning of offshore infrastructures in the Atlantic Region ii)

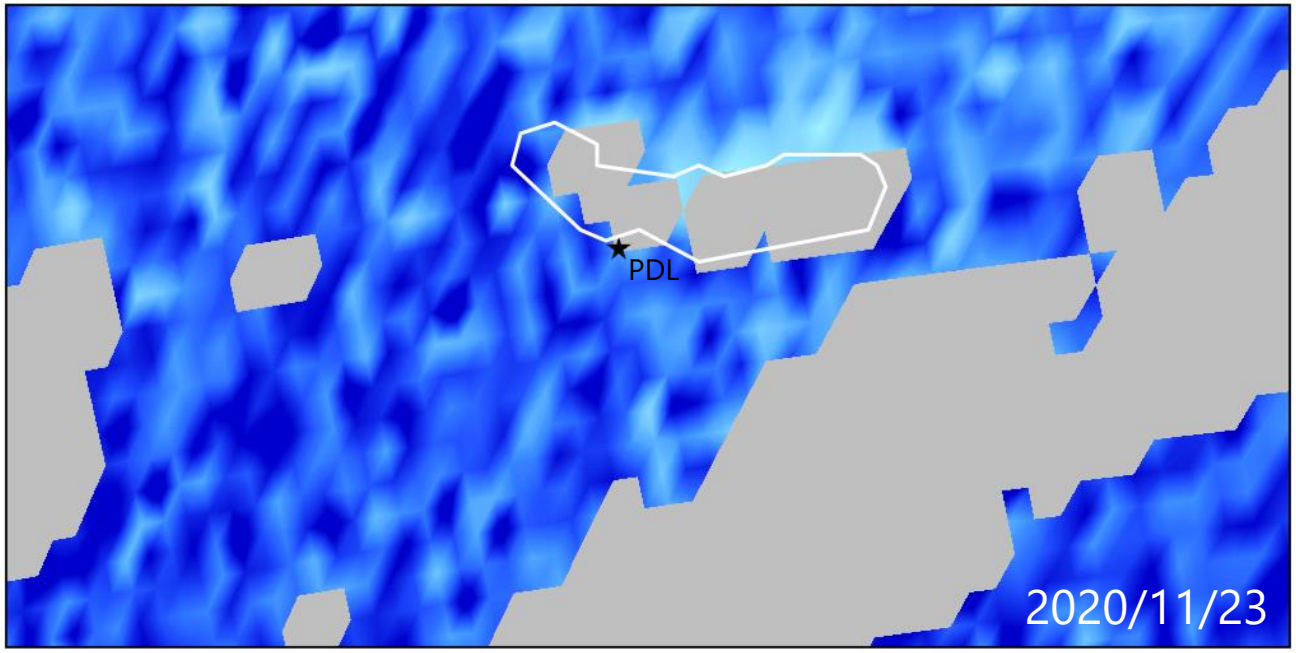
Spectrometer for Marine Litter: Evaluate and develop at a low TRL, prospective technology that in the future can lead to the development of a spectrometer for marine litter detection from space, in particular plastic marine litter

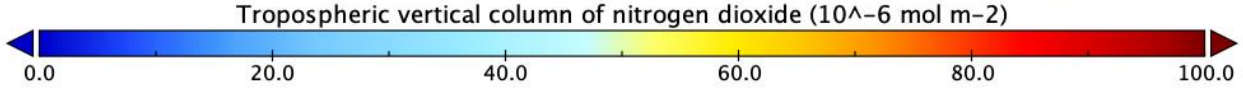
FP-CUP: Increase the number of Copernicus users and applications derived from Copernicus based on user requirements. Expanding the existing markets and creating new markets and competitiveness of European Earth Observation downstream operators.

GDA-AID- Agile EO Information Development Marine Environment and Blue Economy: address the geo-information requirements for organizations such as WB and ADB in their current operations/planning and/or of their strategic goals on the marine environment and Blue Economy on a pre-operational basis to scale up the adoption of value added EO Services.

Ports of the Future: Design an environmental monitoring and management service, moving towards zero pollution port covering water and air quality, using EO, meteo, oceanographic and CCTV data sources, with AI.







PortXXI

- **Identify and evaluate the deployment of transformative environmental monitoring and management services;**
- **Help ports minimize their environmental impact, while keeping operational costs contained;**
- **Use EO, SATCOM and SATNAV infrastructures in combination with CCTV, in-situ and mobile sensors, data repositories and autonomous robotic solutions;**
- **Incorporate Big Data and AI techniques for automatic knowledge extraction.**

Project developed by:

INESCTEC, AIR CENTRE, amberjack SOLUTIONS, IN+ CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH, PORTOS dos AÇORES, Moniport

Stakeholders:

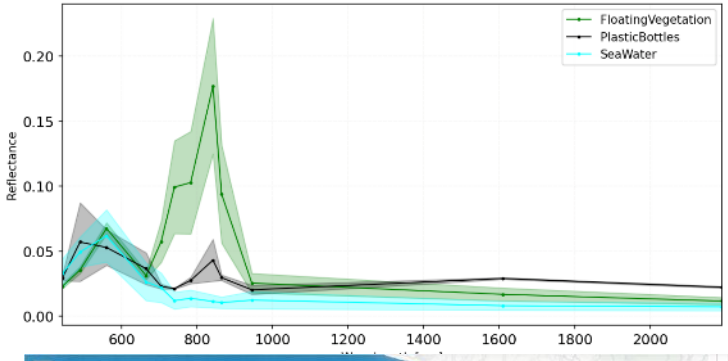
CMC CLUSTER MARÍTIMO DE CANARIAS, GOVERNO DOS AÇORES, APP Portos de Portugal, PORTO DE LEIXÕES APDL, Porto de Aveiro, Porto de Lisboa, PORTO DE SETUBAL, EMERGE STARTUPS INNOVATION, Enapor Portos de Cabo Verde, Puerto de Huelva, UTA UNIVERSIDADE TÉCNICA DO ATLÂNTICO, esa

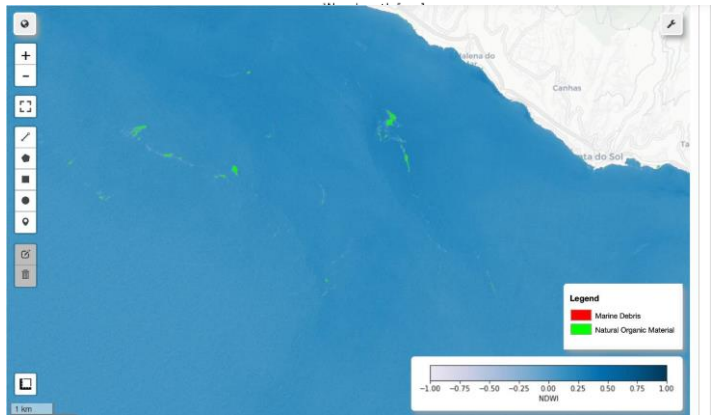
Earth Observation Lab

Machine Learning for Marine Litter D&C and Super Resolution

Classification Algorithms

Distinction and classification of marine litter through a library of spectral signatures and indexes based on Sentinel-2 bands.





Classification Improvement by Super Resolution

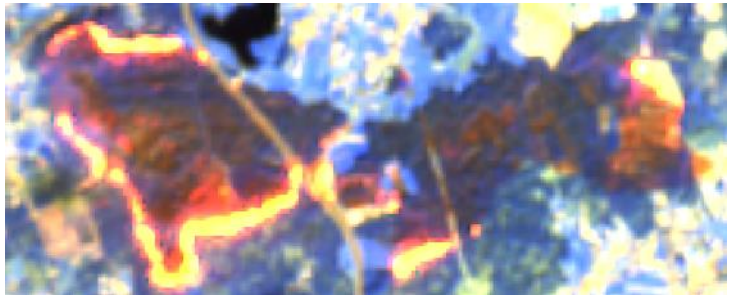
Super Resolution Algorithms

Example: Sentinel-2, 2019-03-26, Wildfire, Marinhas (Portugal)

Original

Bands:

4,3,2



Bilinear

Bands:

12,11,8A

DSen2 by Lanaras

Bands:

12,11,8A

Earth Observation Lab
COVID -19 Observatory

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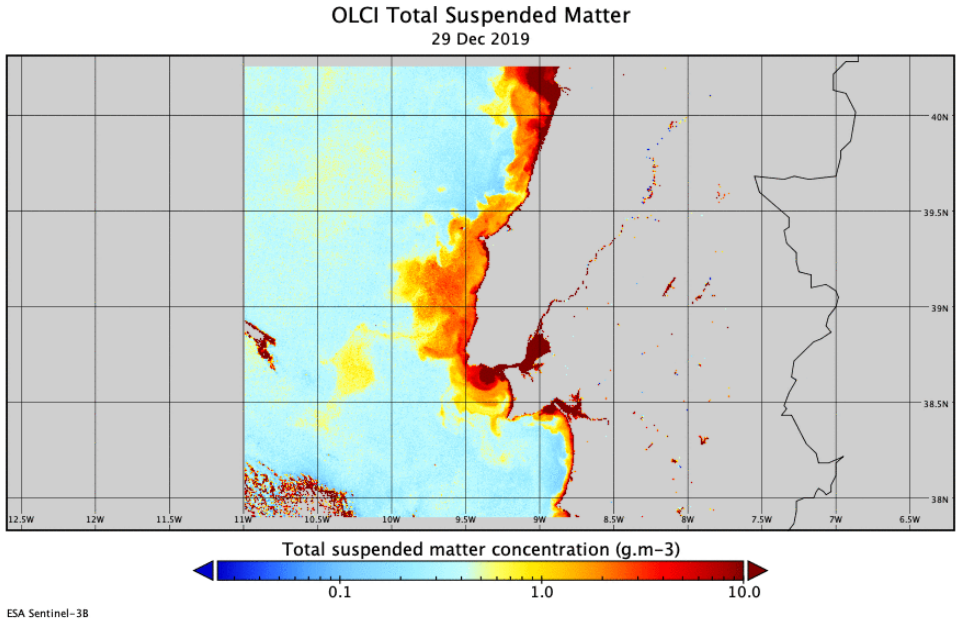
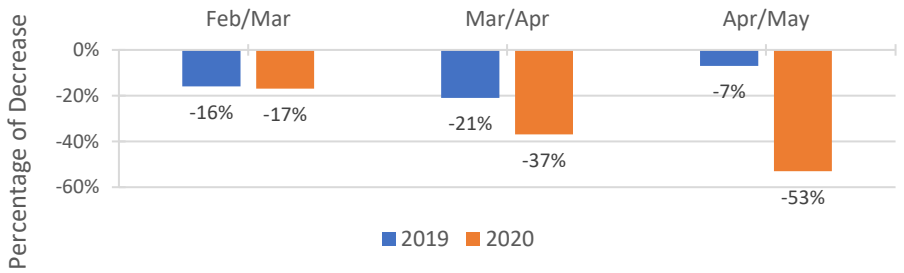
Water Quality Satellite based

- Water quality indicator TSM (Total Suspended Matter) for Portuguese Coastal waters indicate a decrease on its concentration since the COVID confinement started.
- TSM seasonal reduction pattern much more pronounced in 2020 when compared with the same period of 2019.
- As TSM levels decrease, the appearance of the water becomes clearer as light penetration increases.



Comparison of TSM Differences in 2019 and 2020



Early Warning System
Informing Farmers with EO Data

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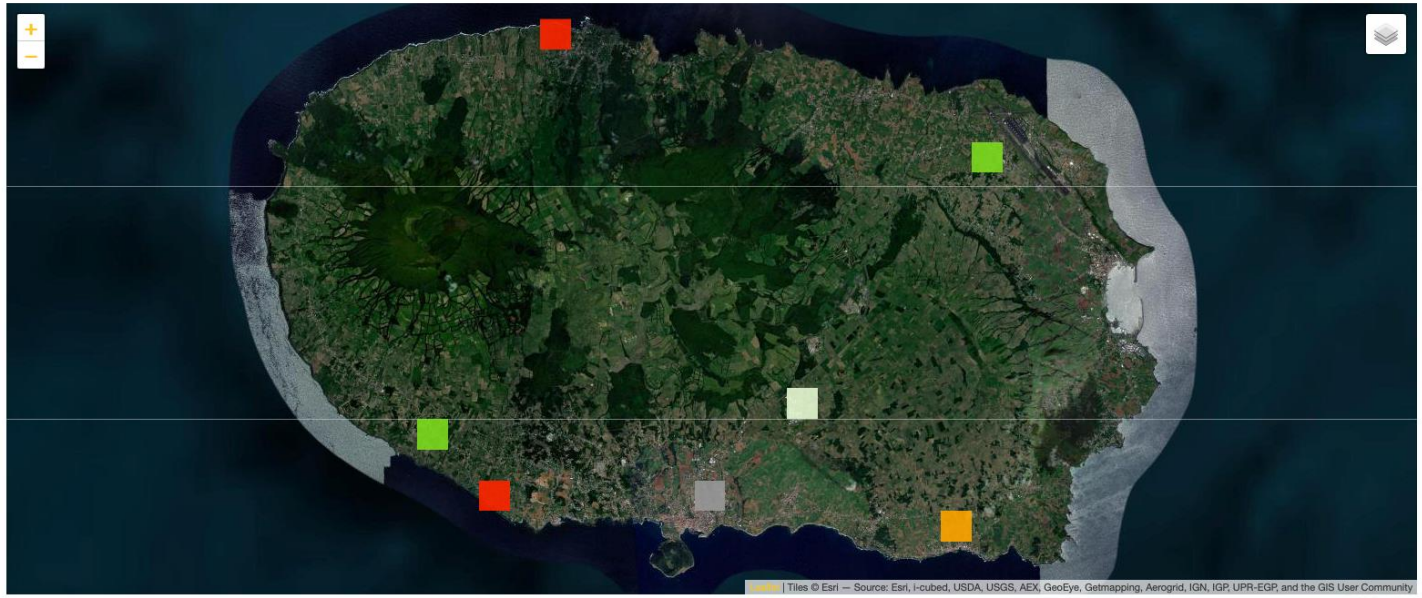
Web application

AIRCentre - Sistema de Alerta *Pithomyces chartarum* | Alertas | Esporulação Corrente | Histórico de Esporulação | Eczema Facial | Setores | Infraestrutura

Satellite data — Alertas de Risco — **In-situ data**

Mapa do Risco de Esporulação Pithomyces *chartarum* baseado em valores de temperatura e humidade; atualização horária 10 minutos depois da hora.

Últimos dados de 2021-01-18 07:00:00



A esporolação ocorre após 72 horas consecutivas de condiçoes atmosféricas favoráveis.

Legenda

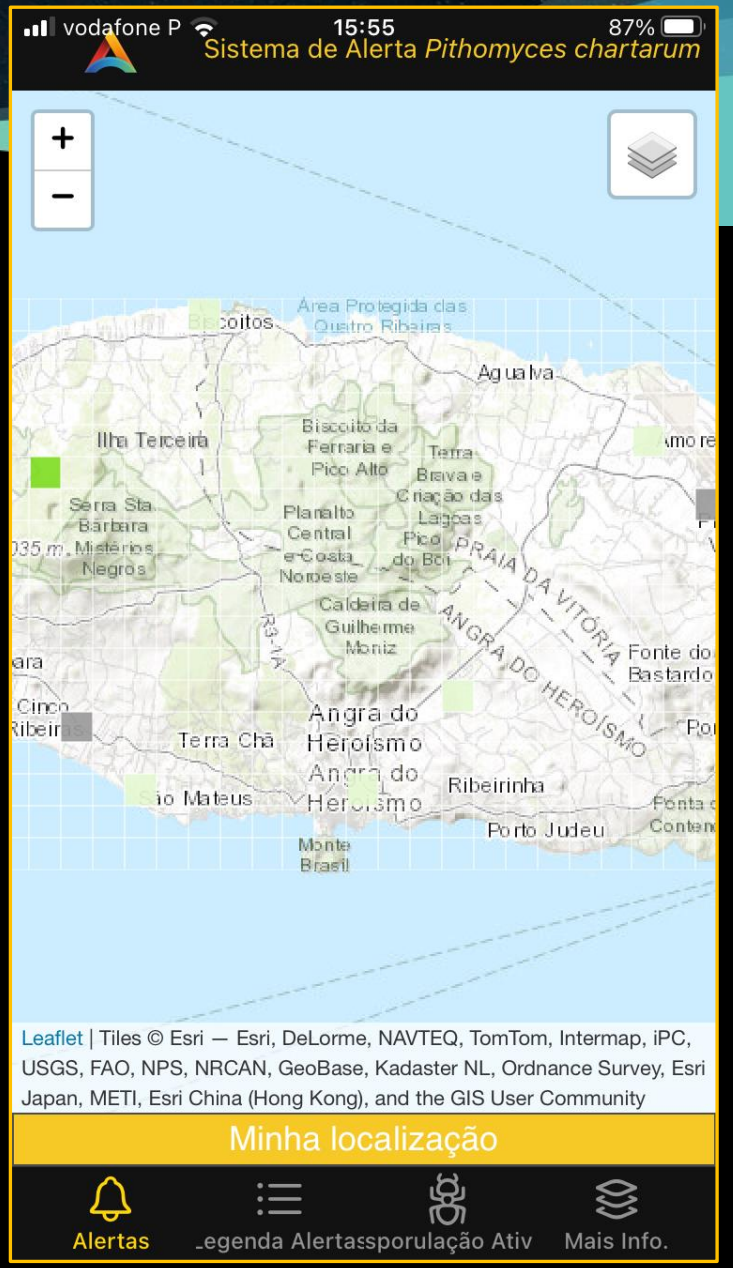
- MONITORIZANDO - Risco muito baixo. Não existem condiçoes atmosféricas favoráveis à esporolação.
- RISCO BAIXO - Condições atmosféricas favoráveis à esporolação reunidas por menos de 24h.
- RISCO MODERADO - Condições atmosféricas favoráveis à esporolação reunidas por mais de 24h e menos de 48h.
- RISCO ALTO - Condições atmosféricas favoráveis à esporolação reunidas por mais de 48h e menos de 72h.
- RISCO MUITO ALTO - Condições atmosféricas favoráveis à esporolação reunidas por mais de 72h.
- SEM DADOS - Setor em monitorização mas momentaneamente sem dados.
- Setor com alerta RISCO MUITO ALTO recentemente - Esporulação pode ter sido iniciada recentemente.

UNICOL

TERinov

LABORATÓRIO Regional de Veterinária

Mobile application



AIR CENTRE

AIR Datacentre

Data centre + Direct Receiving Station

Data

Near real-time

Eart Observation Data Access via API (soon)

Catalogue at https://aircentre.io/app/apis/

Compute Services

Co-location (available now)

Insfrastructure-as-a-Service (soon)

Platform-as-a-Service (soon)

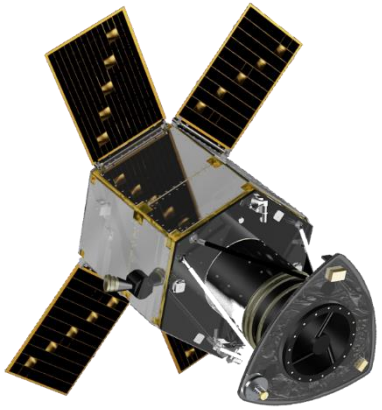
Software-as-a-Service (soon)

Including Data Science Platform

Core Switch 2 x 2 100Gbps
High-av. NVMe storage

Earth Observation Lab

Infrastruture – Acces to high-resolution satellite data



GEOSAT-2

2014-2025
12km swath @ 75cm
2 days' revisit
Pan+4 bands (R,G,B,NIR)

GEOSAT-1

2009-2023
625km swath @ 22m
2-3 days' revisit
3 bands (R,G,NIR)

CAPACITY BUILDING
Earth Observation Training Events

- Training Course to Explore and Uptake the Products of Copernicus Marine Services (March 21, 2023)
- Training Course on Sentinel-3 Image Processing (March 20, 2023)
- Global Workshop on Earth Observation with Julia (January 9-13, 2023)
- Workshop Improvement of capabilities of desalination in Cape Verde (May 25-26, 2022)
- Workshop Desalination in Senegal (November 10-11, 2022)
- Workshop Data usage and tools for Ocean Monitoring using Copernicus (March 15, 2022)
- Workshop Data usage and tools for Coastal Communities using Copernicus (March 16, 2022)

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Capacity Building - Training

Harness new hardware

JuliaEO

Global Workshop on
Observation with Julia

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Outreach

Inspiring Newer Generations

Satellite Technologies for Sustainable Urban Development

Project Concept Note (Draft)

Project Title: **Satellite Technologies for Sustainable Urban Development**

Duration: **24 months**

Implementing Organisation(s): **UNCTAD and AIR Centre**

Indicative budget: ***Eur 75.000*** (Pilot)

Countries: ***10 Developing countries****, particularly least developed countries, and small island countries*

Outcomes

- Improved capacities to access and analyse data using satellite technology for sustainable urban development
- Enhanced capacities to monitor and track progress towards SDG 11 and 6 using satellite technology

Satellite Technologies for Sustainable Urban Development

Phase 1 - Pilot

Expected Outputs

- Improved ability of participating countries to use satellite data for applications that promote sustainable development
- Improved resilience of participating countries to natural disasters through improved warning systems using satellite data
- National reports on relevant issues obtained through improving satellite data analysis capabilities (water, urban development or others)
- Documentation of results obtained and lessons learned for further dissemination

Satellite Technologies for Sustainable Urban Development

Project Concept Note (Draft)

Activities

- Training of the national operational staff to gather and analyse gathered data
- Regional workshop to disseminate the outcome of the project
- Advisory missions
- Installation/upgrading of data gathering facilities

Satellite Technologies for Sustainable Urban Development

Project Concept Note (Draft)

Countries

- TBD

Project Development

- Confirm participating countries
- Identify local partner institutions
- Identify needs/use cases (Disaster resilience and water quality monitoring)
- Identify Copernicus (and other open) data sources and methods
- Identify training team and develop content
- Organise training workshops
- Report on the project

Satellite Technologies for Sustainable Urban Development

Capacity-building Content

- Identify, locate and ingest relevant satellite data
- Manipulate, clean, analyse and interpret data
- Generate information to support policy-making
- Support reporting on progress for SDGs

Satellite Technologies for Sustainable Urban Development

The EO Lab Experience

From Use-case To Community Support

AIRCENTRE

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Head of Data Science, Cloud Infrastructure and Development

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