Observing the Ocean and Earth with

SMART CABLES

JTF SMART Cables Plenary Teleconference

Bruce Howe
Chair, JTF SMART Cables

Mike Constable
Vice-Chair, JTF SMART Cables

ITU/WMO/UNESCO-IOC
JTF SMART Cables
Plenary Call
November 6, 2024

Openning Remarks

Bruce Howe
Chair, JTF SMART Cables

Bilel Jamoussi
Chief of the Study Groups Department
at the ITU Standardization Bureau

ITU, WMO, UNESCO-IOC
REPORT OF WORK

UN SPONSOR AGENCIES

Official Liaisons

Hiroshi Ota, Secretariat
JTF SMART Cables

Enrico Fucile, Head
Data and Information Management
at WMO

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unesco

TSUNAMI

Bernardo Aliaga, Director Tsunami Programme

GOOS

Emma Heslop, Programme Specialist Global Ocean Observing System

OCEAN DECADE

Terry McConell, Lead Decade Coordinating Office, Ocean Observing

Observing the Ocean and Earth with

SMART CABLES

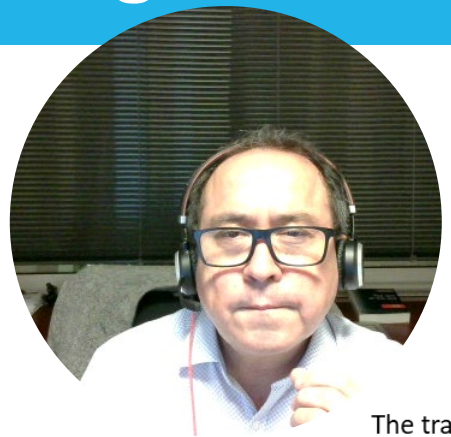
JTF SMART Cables Plenary Teleconference

Bernardo Aliaga Rossel
Head Tsunami Resilience Section IOC of UNESCO

06 November 2024
Virtual Call

ITEM 1.D. UPDATE OF WORK TSUNAMI RESILIENCE SECTION OF IOC

We have gone a long way



1948 the **Honolulu Magnetic Observatory**, under the US Coast and Geodetic Survey (USCGS)established

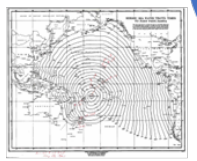
ITSU renamed

September 2005, Vina del Mar, Chile

The 20th Session of the ICG/PTWS-XX decides to change its name to the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System

ITSU development

ITSU
IOC/IV-6, International Aspects of the Tsunami Warning System in the Pacific, Paris, November 1965

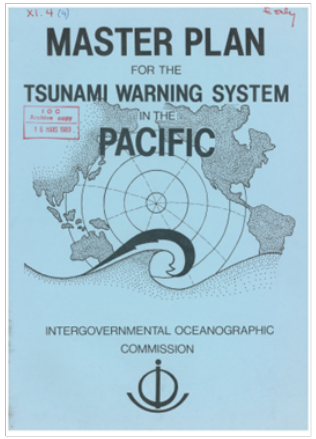


1965

1952. The Japan Meteorological Agency started its national tsunami warning center

1977
The Honolulu Observatory renamed Pacific Tsunami Warning Center PTWC

1989
First Master Plan



1965 - IOC Working Group on the International Aspects of the Tsunami Warning System in the Pacific, organized by the USCGS on behalf of the IOC, Honolulu, 27-30 April 1965

The tragedy brings world attention to the dangers of tsunamis in every nation and initiates the development of warning and mitigation systems in the Indian Ocean

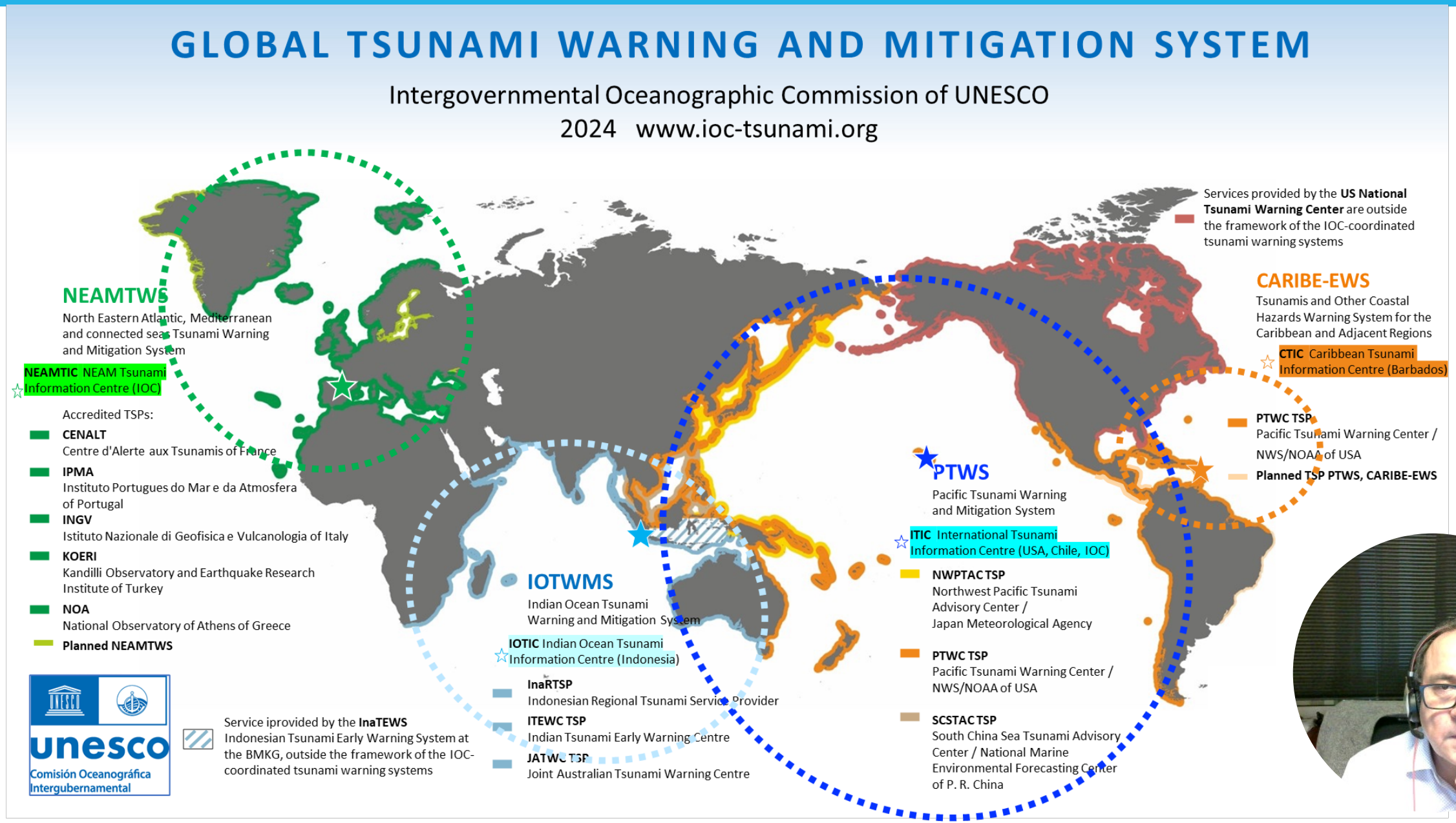
Indian Ocean Tsunami

2004

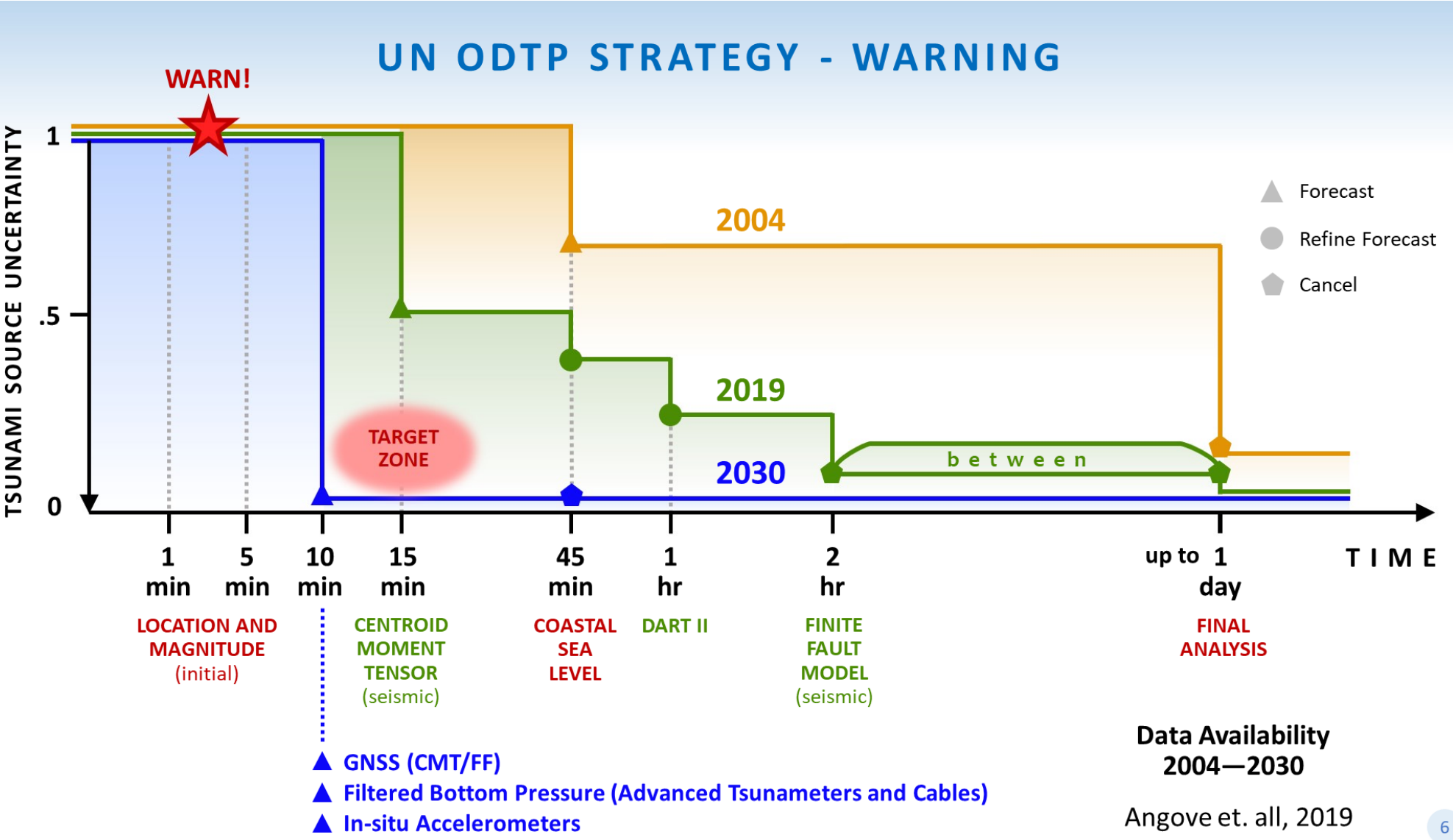
2005
3 ICGs established

Indian Ocean (ICG/IOTWS), Caribbean and Adjacent Seas (ICG/CARIBE-EWS), Mediterranean and North Atlantic (ICG/NEAMTWS) (IOC/XXIII-11, 12, 13, **June 2005**)

And we developed a mature system



That it is willing to expand on timely warnings



Data Availability 2004—2030

Angove et. all, 2019

And on community preparedness

UN OTDP STRATEGY -

THE MAIN SOCIAL OUTCOME

TO MAKE **100%** OF COMMUNITIES AT RISK OF TSUNAMI PREPARED FOR AND RESILIENT TO TSUNAMIS BY **2030**

From last year and future plans

Liaison consultant for JTF based in Europe and hired at UNESCO with support from JTF (Juan Jose)

Connected all tsunami regional based groups with JTF

Facilitated tsunami community contacts for JTF visits in regions
Participated in key meetings/workshops organized by JTF

Using as a template the Agreement between CTBTO and UNESCO, which allows transmission of high-quality and real-time CTBTO International Monitoring System (IMS) seismic, hydroacoustic, infrasound and radionuclide data with a very high data availability rate to the National Tsunami Warning Centres (NTWCs) recognized by UNESCO, we would like to explore with ITU if a similar arrangement could be developed for SMART Cable data

SMART CABLES

ITU unesco WMO

GORDON AND BETTY MOORE FOUNDATION

Schmidt Marine TECHNOLOGY PARTNERS

SMARTCables.org

ITU/WMO/UNESCO IOC Joint Task Force

Scan to Join!

The Global Ocean Observing System

Integrating SMART Cables into GOOS

Emma Heslop, Programme Specialist Global Ocean Observing System (GOOS)
IOC/UNESCO

GOOS: A critical infrastructure for ocean observing

Ecosystem of providers
Observation infrastructure

Ocean observing community & partners

Global Ocean Observing System

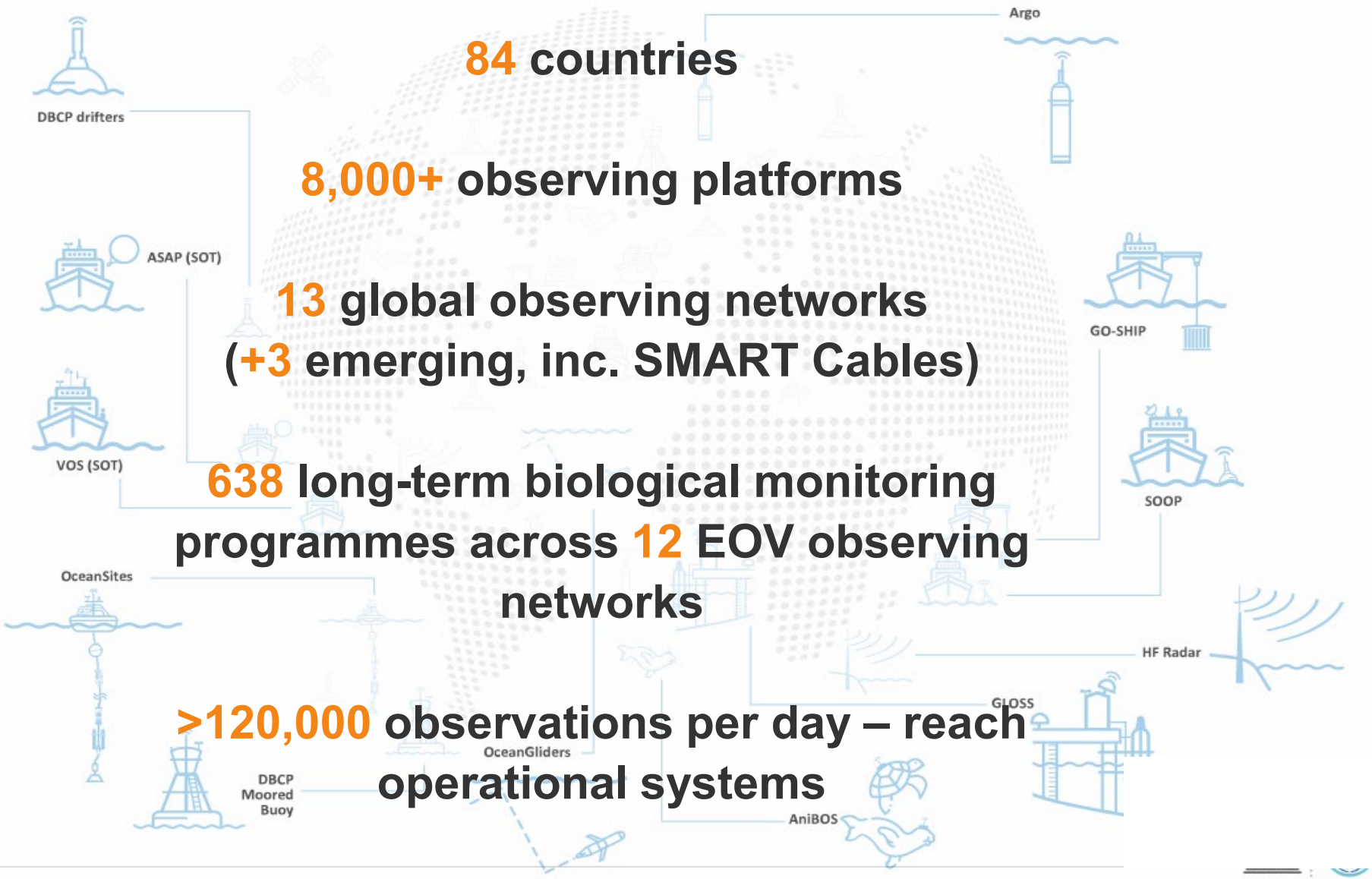
The Global Ocean Observing System

GOOS Management Team
Coordination – Integration - Advocacy

Beneficiaries of ocean information

Research, Decision makers, Users, Investors

GOOS Today



84 countries

8,000+ observing platforms

13 global observing networks (**+3** emerging, inc. SMART Cables)

638 long-term biological monitoring programmes across **12** EOV observing networks

>120,000 observations per day – reach operational systems

Integrating SMART Cables

Evolution

- 2023 GOOS Project (innovation, limited duration)
- 2023 Bottom Pressure adopted as an Essential Ocean Variable (EOV)
- **2024 adopted GOOS Observation Coordination Group (OCG) 'emerging' network**

Benefit:

- Respond to global societal needs
- Visibility as part of GOOS
- Leverage collective knowledge, frameworks, data flows
- Data (provenance) visible in GOOS – IOC
- Influence development OCG GOOS

Work ahead:

- Advance maturity of network
- Participate in OCG meetings and TT's
- Connect OceanOPS (metadata)
- Network specification sheet
- Ensure ready to integrate data streams as go live

News

Three emerging observing networks join the Global Ocean Observing System

Article on GOOS Website

	Global in scale - Greater than regional, and as far as feasible, intention to be global.
	Observes one or more EOVs or ECVs - Contributes to meeting requirements through observing one or more of the GOOS Essential Ocean Variables or GCOS[1] Essential Climate Variables.
	Observations are sustained - Sustained over multiple years, beyond time-span of single research or experimental projects, undertaking routine, systematic and essential ocean observations
	Community of Practice - Has an identified governance structure that provides a means of developing a multi-year strategy and implementation plan.
	Maintains network mission and targets - A role in the GOOS is defined and progress towards targets can be tracked and progress assessed.
	Delivers data that are free, open, and available in a timely manner - Has a defined data management infrastructure that provides data on a free and unrestricted basis, in real time where possible, as well as FAIR-compliant[2] data services for real time and delayed mode data.
	Ensures metadata quality and delivery - Complete platform metadata is submitted to OceanOPS in a timely manner.
	Develops and follows Standards and Best Practices - Make accessible, develop, document, follow, and update best practices encompassing the observation lifecycle[3].
	Undertakes capacity development and technology transfer - Development of activities that enable new (developing and disadvantaged) communities of ocean observers and supports inclusivity and diversity in its members.
	Environmental stewardship awareness - Actively develops ideas to minimize environmental footprint and contributes positively towards a healthy ocean.

The Global Ocean Observing System

Thank you

goosocean.org

unesco
Intergovernmental Oceanographic Commission

WORLD METEOROLOGICAL ORGANIZATION

UN environment programme

International Science Council

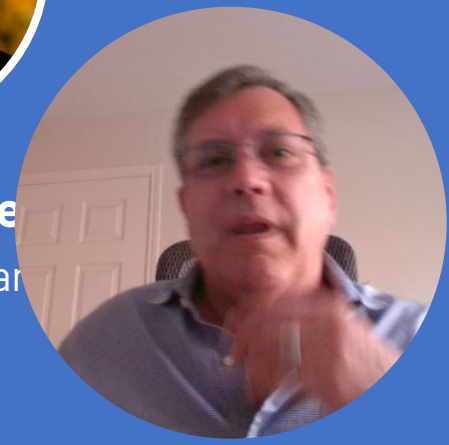
Ocean Decade Coordination Office
Ocean Observing

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

UN Ocean Decade
&
DCO - Ocean Observing

November 5, 2024

Terry McConne
Lead, DCO – Ocean



Ocean Observing | Ocean Decade Coordination Office

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The Global Ocean Observing System GOOS

- **The Ocean Decade** in a snapshot
- **Ocean Observing** within the Decade

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

THE OCEAN DECADE

in a snapshot

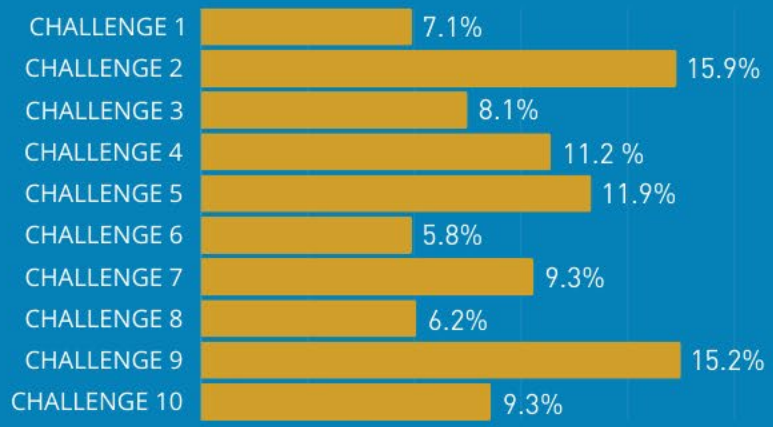
As of June 2024

ENDORSED OCEAN DECADE ACTIONS

56 PROGRAMMES **99** CONTRIBUTIONS
401 PROJECTS **784** ACTIVITIES

DECADE ACTIONS LED BY PARTNERS FROM **66** COUNTRIES

ENDORSED ACTIONS PER CHALLENGE



REGIONAL AND NATIONAL COORDINATION

12 DECADE COLLABORATIVE CENTRES/ COORDINATION OFFICES

16 DECADE IMPLEMENTING PARTNERS

38 NATIONAL DECADE COMMITTEES

6 REGIONAL TASKFORCES AND PROGRAMMES

OCEANDECADE.ORG

@UNOceandecade

@un-ocean-decade

ENGAGEMENT AND OUTREACH

7 INFORMAL WORKING GROUPS

11 PATRONS AND **19** INSTITUTIONAL MEMBERS OF THE OCEAN DECADE ALLIANCE

OVER **20** MEMBERS OF THE FOUNDATIONS DIALOGUE

8800 MEMBERS FROM **173** COUNTRIES ON THE OCEAN DECADE NETW

1.5+ M
REAC

Ocean Observing | Ocean Decade Coordination Office

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The Global Ocean Observing System GOOS

Recent Decade Publications:

- An Ocean of Life
- Vision 2030 Outcomes Report

Ocean Observing | Ocean Decade Coordination Office

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The Global Ocean Observing System GOOS

Ocean Decade Approach at UNOC 2025:

Focus on new initiatives and knowledge generation aligned with Barcelona priorities

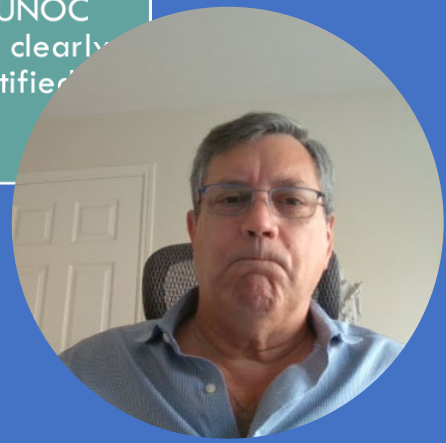
Ocean Decade Initiatives in development

- Investment in Ocean Science inc. philanthropic engagement
- Marine Pollution
- Seabed Mapping / Industry Data Sharing
- ILK in the Ocean Decade
- Diversity, Inclusivity & Equity (youth & gender)
- Coastal cities

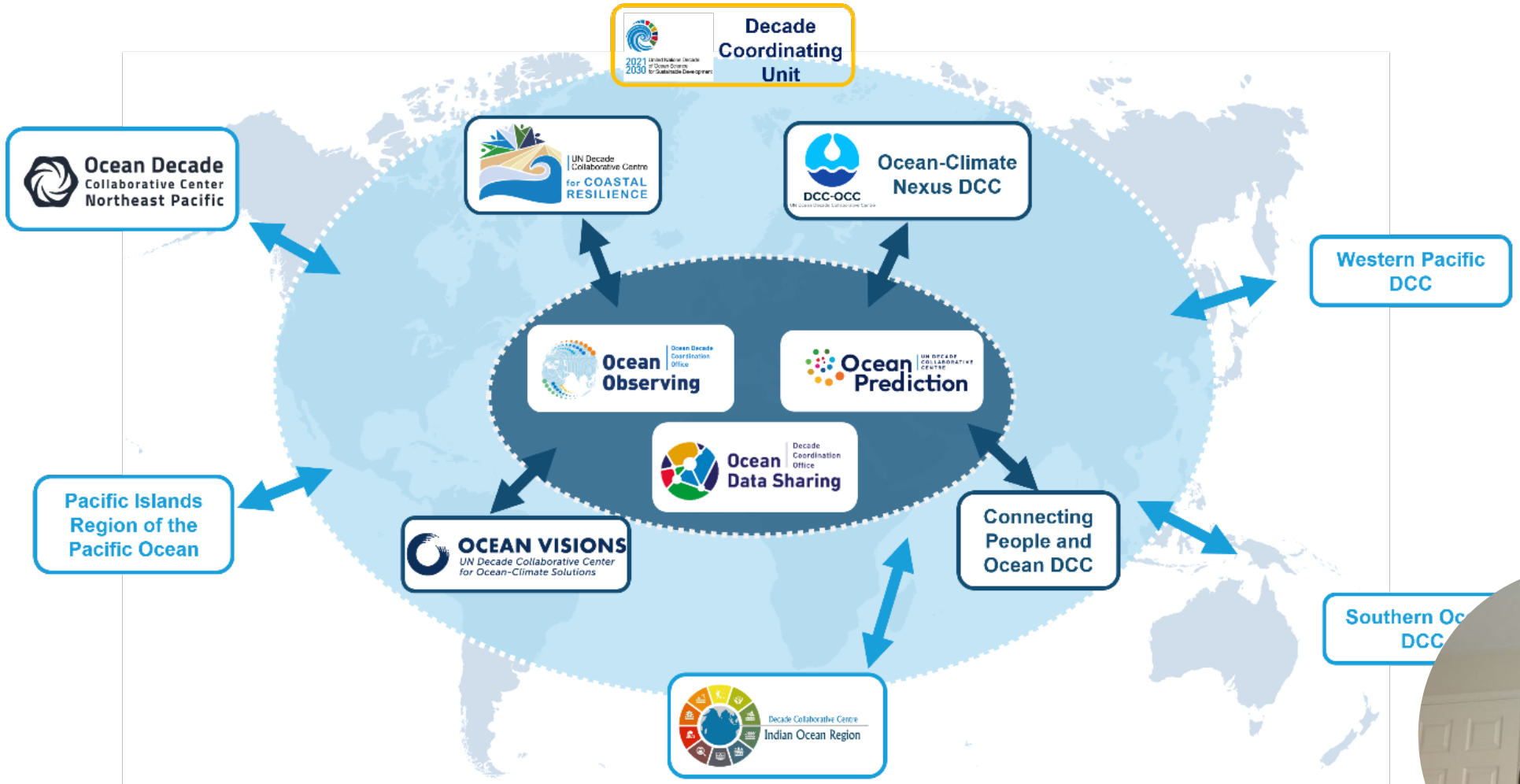
→ Constituency building & new knowledge in lead-up to UNOC inc. milestone events

→ Visibility & awareness via launch and events at UNOC

→ Post-UNOC actions clearly identifie



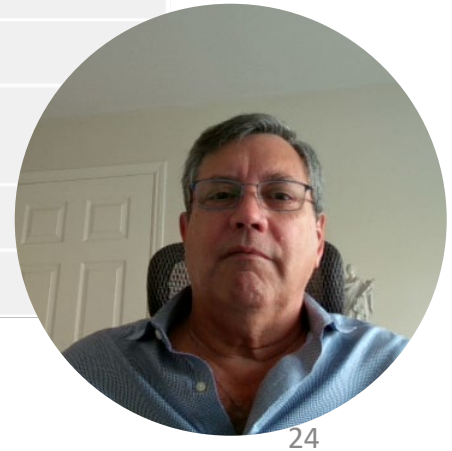
DCO – Ocean Observing within the Decade



The DCO-Ocean Observing Programmes Group

11 OCEAN OBSERVING PROGRAMMES and 91 PROJECTS
(25% of Decade Actions)

Name	Description	Lead Institution
OneDeepOcean	Ocean network for **deep observation**	Ifremer, France
CoastPredict	Observing and predicting the **global coastal ocean**	Alma Mater Studiorum University of Bologna, Italy
Seabed 2030 Project	**Bathymetric** map of the entire ocean by 2030	Nippon Foundation-GEBCO, Monaco
ODRP-MAE	Research on the maritime **acoustic environment**	Interagency Working Group for Ocean Sound and Marine Life, US
Marine Life 2030	Global integrated **marine biodiversity information management and forecasting** system.	Marine Biodiversity Observation Network (MBON).
OBON	Ocean **biomolecular observing** network	POGO , UK
OASIS	Observing **air-sea interactions** strategy	SCOR Working Group, US
DOOS	**Deep ocean** observing strategy	DOOS Working Group, US
Ocean Observing Co-Design	**Evolving ocean observing through co-design** to deliver the information nations need	GOOS, UNESCO IOC
Observing Together	Meeting stakeholder needs and **making every observation count**	GOOS, UNESCO IOC
Challenger 150	A decade to study **deep ocean sea life**	DOSI, UK



DCO – Ocean Observing Vision

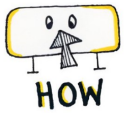
Institutional strategy: Cohesive, coordinated and interoperable ocean observing systems; global, regional and national

Community Engagement: Private sector and societal participants in the Blue Economy and a healthy Ocean

Sustained Ocean financing: Innovative, long-term finance for a sustainable Global Ocean Observing system

Prioritization of societally relevant observing requirements: Geographic & Thematic.

Standardization around universally agreed EOVs, ECVs and measurement & data management best practice.



Capacity Development: Ensure equitable access to observational data and technology for all stakeholders

Technology Development: Autonomous & low-cost sensors. Complementary use of remotely sensed & in-situ data

Ocean Decade Coordination Office
Ocean Observing

A global ocean observing system responsive to the needs of end users; enabling a healthy, resilient ocean and sustainable blue economies.

END-USER APPLICATIONS

Ocean Prediction
UN Decade Collaborative Centre

Ocean Data Sharing
Decade Coordination Office

Ocean Observing | Ocean Decade Coordination Office

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

The Global Ocean Observing System GOOS

Discussion

t.mcconnell@unesco.org

JTF COMMITTEES REPORT

JTF – Compiled report – Engineering

Steve Lentz, Chair
Engineering Committee
JTF SMART Cables

- Desktop Study Considerations document drafted and published in February with assistance from GBS
- 2016 White Papers Reviewed – papers are still valid and no changes are needed
- Attention is now focused on actual systems (particularly CAM) for which supplier is responsible for engineering (role of JTF engineering in these projects is thus limited)
- Role of JTF engineering will remain focused on helping new projects define SMART capabilities and requirements
- Arctic and Antarctic projects are important areas for further development

JTF – Compiled report – Legal and Regulatory

Tara Davenport, Co- Chair Legal and Regulatory Committee JTF SMART Cables

1.Members of the Legal Committee

a. **Renewal of members:** Tara Davenport has worked towards the renewal of the members with the view to ensure the commitment of members, their availability and interest in being involved into the JTF.
b. **Current composition**: 6 members (Tara Davenport, Irini Papanicolopulu, Louis Savadogo, Sun Zhen, Esteban Restrepo, Virginie Tassin Campanella)
c. **Profile diversity:** 4 academics (including one Member of the International Law Commission) and 2 legal practitioners
d. **On-going efforts to attract new members:** It was agreed that if any of the existing members of the Legal Committee had a recommendation on new members who may be able to contribute meaningfully to the work of the Legal Committee, we would welcome them, including graduate or post-doctoral students who were interested in the topic, if there are any recommendations. Two new members are being considered and hopefully more will be presented by the next meeting.

2.Appointment of a Co-Chair : Virginie Tassin Campanella, current member has accepted to act as Co-Chair. Both Tara and Virginie will work hand in hand and support each other in moving forward with the work of the committee.

3.Initial workplan:

a. Given the resource constraints and the need for a deliverable that would meaningfully contribute to the work of the JTF, it was agreed that the Legal Committee should focus on the analysis of existing data governance and sharing mechanisms under international law with the ultimate objective of developing recommendations/guidelines on data governance and sharing mechanisms in the context of SMART Cables.

JTF – Compiled report – Legal and Regulatory

Virginie Campanella,
Co- Chair
Legal and Regulatory Committee
JTF SMART Cables

b. It was noted that it was important to examine data governance frameworks that entailed public/private partnerships. It was also suggested that we should also look at regional frameworks.

c. It was also agreed that the Legal Committee would need to scope the analysis and that the first step would be to compile a list of existing data governance mechanisms and frameworks that have been established/developed in relation to the marine environment, resources and space.

d. The committee will use a Shared Google Sheets to ensure participation and contribution of all.

4.Meetings of the Legal Committee: The Legal Committee has met twice in 2024, in January 2024 and October 2024. We have tentatively agreed to have Zoom meetings every three months to push the work along. The next meeting has been scheduled for 27 Jan 2025 at 5.30 pm SG time. By then, we hope to have a working list of existing data governance frameworks in order to scope the analysis. Tara and Virginie also agreed that they would look into organizing an in-person meeting in Jan 2026 at the next meeting of the JTF plenary in Hawaii.

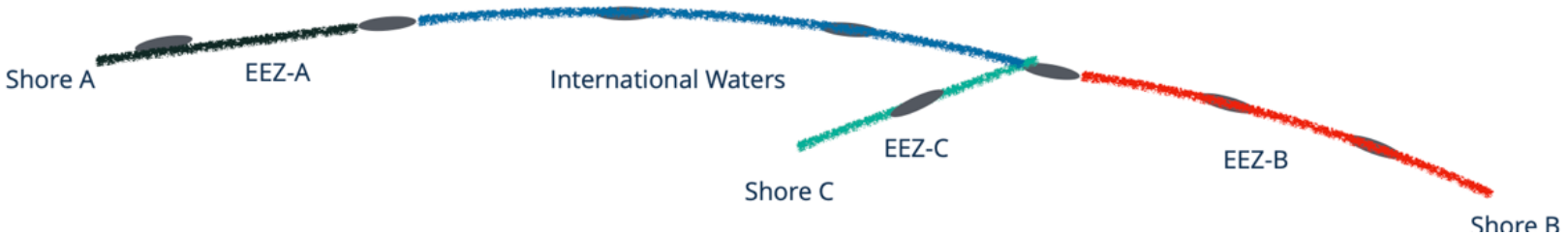
5.Coordination call with the JTF Data management Team : A meeting was organised between Benoit Pirenne, Tara and Virginie to strengthen ties and coordination between the two committees. Benoit Pirenne was invited to conduct a presentation to the next legal committee meeting in January 2025 to further discuss data management and related legal concerns together with the whole legal committee members. Potential adjustments of the workplan will be discussed on this basis.

JTF – Compiled report – Data Management

Benoît Pirenne, Chair
Data Management Committee
JTF SMART Cables

SMART Cable Data Management WG: report

- Data agreement: worked on draft (using Vanuatu - New Caledonia as template)
  - First draft available but needs work
  - Exchanged draft with Legal WG
  - Availability of new draft with Legal WG input by Feb. 2025
- Data Governance
  - Realized that data agreement requires consideration of data governance issues first
  - Data Governance should consider the general case that: Cable ownership ≠ Data ownership, Data ownership can change along cable path, Each data owner can have a different general data access policy, Each sensor can have a different access policy depending on its location, Each sensor type might end up in a different (specialized) data repository
  - So recommend to work on data governance white paper next



JTF – Compiled report – Business Development

Josh Richards, Chair
Business Development Committee
JTF SMART Cables

1. Progress since last call
   - Holding Winter Meeting – end of November
   - Added to shared contacts list for outreach efforts
   - Initiated outreach to scientific agencies in Japan, Europe, and Canada
   - Began compiling potential new funding sources
   - Identified list of countries resistant to SMART

2. Issues/challenges/help needed
   - Request for official JTF designated regions of priority with list of countries in that region available on website
   - Request for map of priority regions available on JTF website – will work with the Science and Society Committee to discuss priorities

Updates from Chairs: Business Development

Josh Richards, Chair
Business Development Committee
JTF SMART Cables

3. Objectives in next 3 months.
   - Work with Science and Society Committee to develop official JTF designated regions of priority with list of countries
   - Work with Science and Society Committee to develop map of priority regions for JTF website

4. Members

Peter Bannister
Emmanuel Danjou
Stephen Dawe
Geoffroy de Dinechin
Guillaume Durieux
Mark Englund
Paul Holthus
John Mariano
Josh Richards
Khaled Sedrak
Dieter Sieber
Jerry Soloway
Torsten Thiele
Motoyoshi Tokioka

Updates from Chairs: Publicity, awareness and marketing

Kate Panayotou, Co-Chair

Joanna ElKhoury, Co-Chair

Publicity, awareness and marketing Committee JTF SMART Cables

In 2024 the Publicity, Awareness and Marketing working group has undertaken the following -

•worked with Ceci to develop marketing material e.g. digital marketing/ website, newsletters, social media, LinkedIn
•engaged with stakeholders for collaborative opportunities with WOC, UN Decade of the Ocean, COP, universities, science users
•attendance and presentation at JTF SMART Workshop Hawaii January 2024
•attendance and presentation for SMART cables at SNW Singapore September 2024
•through engagement with UNWA and AIMS (Lyndon and Phil) it was identified that there is no current interest in SMART Cables in Australia. Note that Fibre Sense has been working to have their technology across projects in Australia.

Goals for 2025

•Assess the success of previous / current pilot projects to use as positive marketing and how data is being used / can be used
•Leverage JTF workshop in Hawaii January 2025 for social media releases
•Work alongside our other working groups to better understand the data that end users could have access to and how
•Work with WOC and UN Decade / COP to further raise JTF Smart profile and how useful data could be.
•Meet with WOC Stewart Sarkozy-Banoczy, who will become the WOC Acting CEO, as Paul Holthus retires.
•Assess branding agency activities for 2025
•Update events calendar for the JTF for opportunities to accelerate SMART Cable marketing and awareness for 2025
•Develop budget for publicity, Awareness and Marketing for 2025
•Maintain and continue to update website
•Send invites to new members to register and follow JTF SMART
•Attend PTC and ICPC 2025

RELATED ORGANIZATIONS REVIEW ON SENSORS

Related Organizations

SUBOPTIC

Valey Kamalov, Chair, Subsea Environmental Sensing with Operational Submarine Cables Working Group

ICPC

Phil Lancaster, Co- Chair, Sensing Working Group

Working Group Charge

Assigned Goals

- Define the sensor specifications required to achieve the science and monitoring goals articulated for SMART cables
- Evaluate the suitability of available (or soon to be available) sensor types for incorporation into SMART cable packages

Modified Goal

- Define the sensor specifications required to achieve the science and monitoring goals articulated for SMART cables and thus provide an objective means to evaluate available and emerging sensors against the observational goals

JTF SMART Cables SRWG

4 Sub-Groups

CORE Sensors

- Pressure and Temperature – Laura Wallace
  - Draft Specs by AGU Fall meeting for community review by end of year
- Seismic – William Wilcock
  - Draft Specs by AGU Fall meeting for community review by end of year

Other Sensors

- Hydrophones – Shima Abadi
  - Standing by to follow template adopted for CORE sensors
- Fiber Sensing – Brad Lipovsky & Veronica Rodriguez Tribaldos
  - A lot of excitement but end product unclear

Temperature

- Heat storage & sea level rise
- Ocean circulation
- Coastal shelf exchange processes
- Impact of temperature changes on ecosystem
- Submarine mass transport (turbidity currents)

0.001°C resolution, 0.001°C/yr stability

Pressure

- Tsunami waves
- Mass change within the oceans
- Global and regional ocean circulation
- Seafloor geodesy
  - Earthquakes displacement
  - Slow slip events
  - Secular strain
- Strong motion seismic sensor
- Weak motion seismic sensor (Rayleigh waves)
- Submarine mass transport (turbidity currents)

Seismology

- Earthquake early warning
- Tsunami forecasts
- Teleseismic earthquakes - catalogs and internal structure of the Earth
- Regional earthquakes - catalogs, plate boundary processes, imaging
- Local microearthquakes – volcanoes, plate boundary processes
- Non-volcanic tremor and repeat earthquakes for slow-slip on faults
- Ambient noise tomography and temporal monitoring
- Site responses - near surface sedimentary/tectonic processes & slope stability
- Seafloor motion from slumping of unstable slopes and fault motion
- In the absence of hydrophones, recording acoustic signals propagating in the water column (Marine mammals, T-phases, Ships)

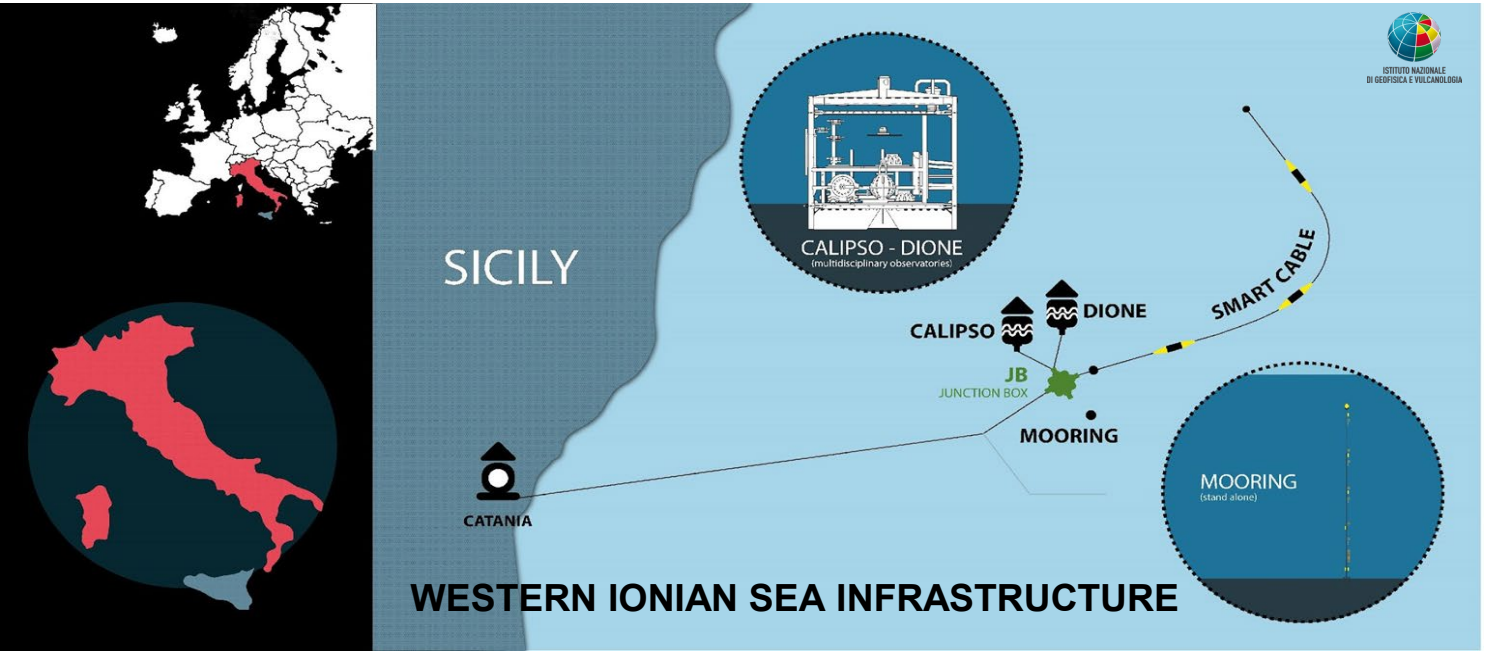
Current Status

- It has been challenging to keep people engaged
- The group and particularly the Seismic Sub-Group are very interested in the results of the Wet Demo Project - How does the repeater housing and attachment to the cable impact the seismic(and pressure) response?
  - Comparison of earthquake recordings with conventional OBSs
  - Comparison of seismic noise
- December AGU deadline will provide an impetus to complete draft reports for CORE sensors
  - Timeline/process for adoption

Update of FUNDED SMART Cable Systems

Funded SMART Cables Systems

InSEA wet demo SMART cable



- existing EMSO WESTERN IONIAN SEA facility
- 25 km EAST OF CATANIA, SICILY AT 2.100 m depth
- observation area prone to EARTHQUAKES and TSUNAMIS
- INSEA project FUNDED IN 2019 by the ITALIAN MINISTRY OF RESEARCH
- AIMS TO ESTABLISH THE EFFECTIVENESS OF SEISMOMETERS AND ENVIRONMENTAL SENSORS DEPLOYED INSIDE COMMERCIALLY STANDARD REPEATER HOUSINGS

GURALP Systems Ltd, in collaboration with Global Marine Supplies SpA and ELETTRA TLC, worked on the integration of cable/repeaters/sensor pods.

Refurbished repeaters (without tails) and cable (Pirelli 18,5 mm 4 FO, SA/LW) from Columbus 3 Project

Funded SMART Cables Systems

InSEA wet demo SMART cable

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

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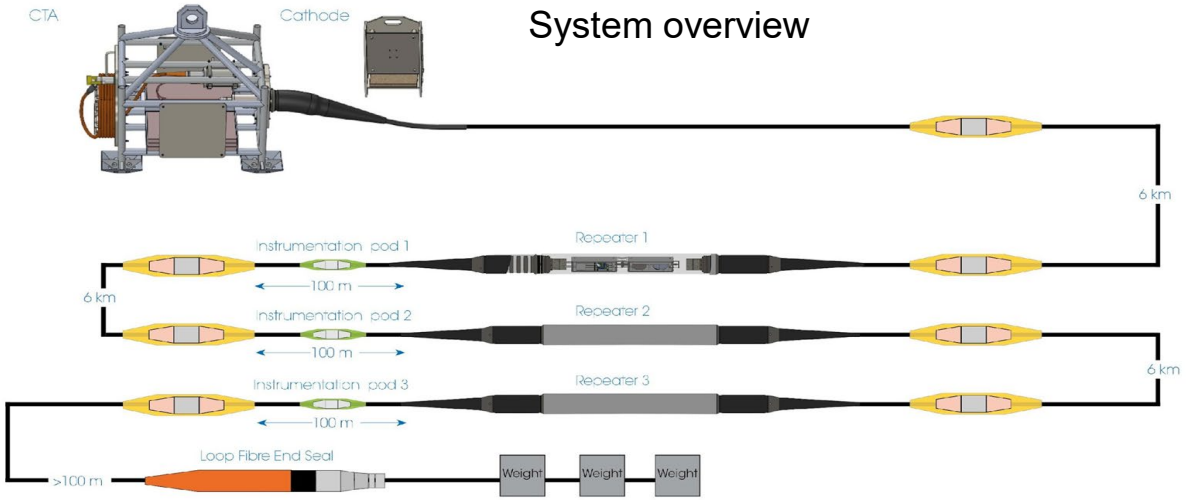
System overview



Power:

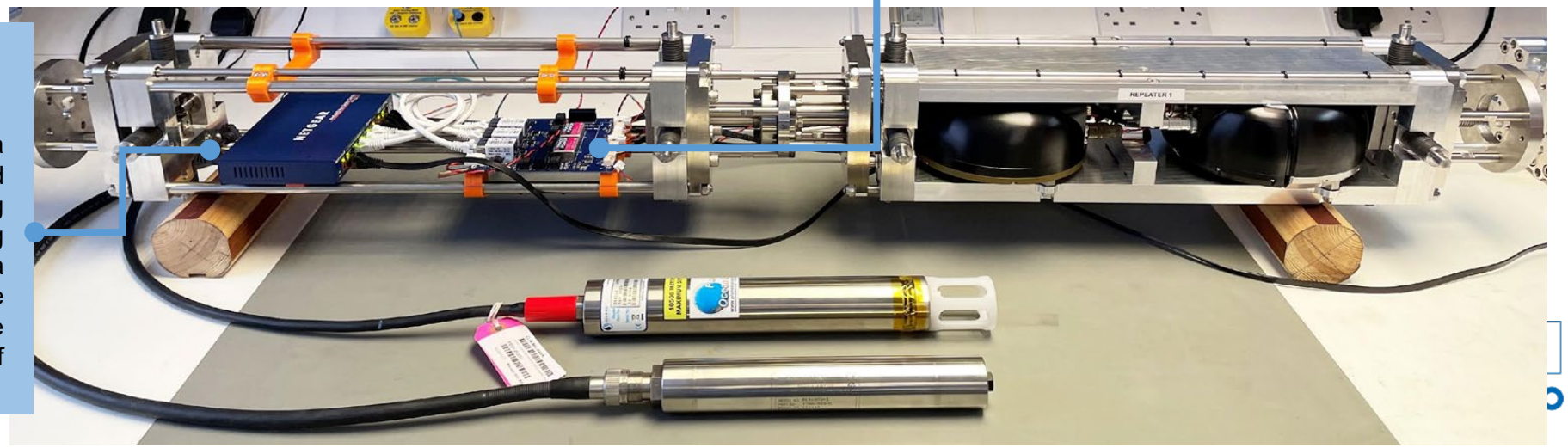
Power and control board

The SMART cable is a single conductor sea return cable. The power is provided to the repeaters by means of constant current power supply. Each instruments, both internal and external, could be individually power on/off.

Communication and timinig:

Switch implementing hardware PTP

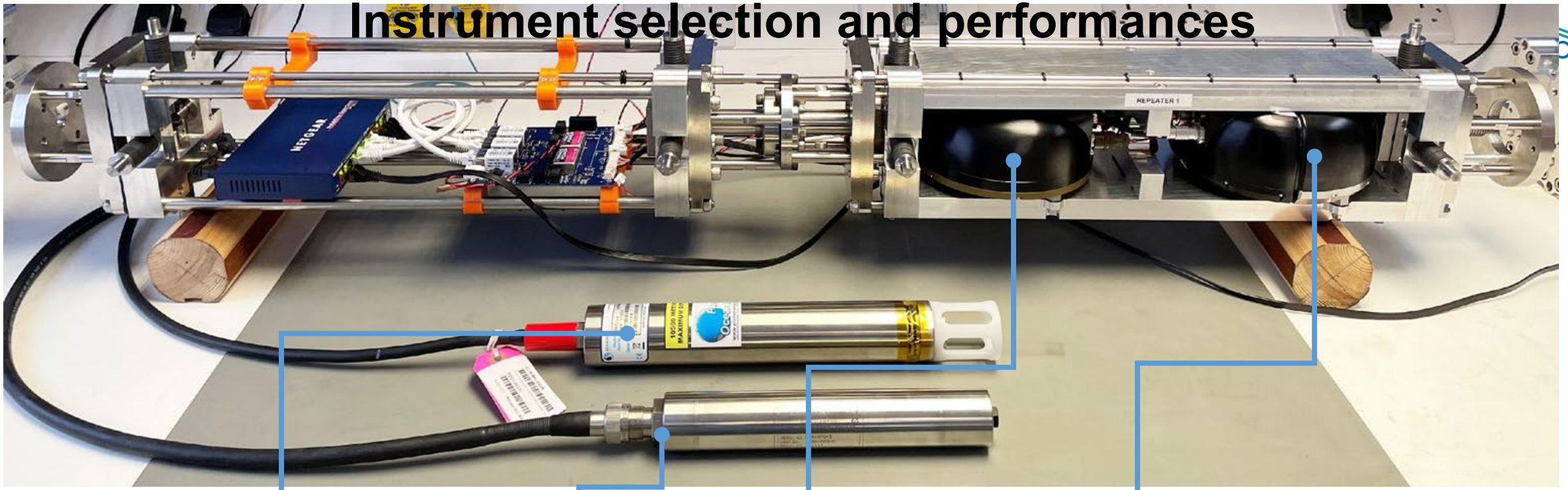
The communication is handled by a switch hosting the lasers and implementing the Precision Timing Protocol. The PTP provide the timing signal to the instruments with a precision <1us. The SMART cable use two fiber in a ring topology to provide redundant communication in case of repeater or fiber failure.



WMO

Funded SMART Cables Systems

Instrument selection and performances



Instrument pod:

Seabird SBE 39Plus
The temperature sensor selected has an operating range between -5°C and 45°C with an accuracy of ±0.002°C. The sensor will help to facilitate the monitoring of sea floor oceanographic conditions and will feedback into existing oceanographic models.

Paroscientific 8000 Series
This APG has a depth rating of 3,000m and a precision of <0.01% full scale range. Selected for proven performance and robustness, the Paroscientific 8000 has been successfully used in other Güralp ocean bottom sensing systems. It has also proven crucial for tsunami warning systems globally.

Repeater:

Fortimus
A modern force balance accelerometer with integrated digitiser. It has a flat acceleration response between DC-315 Hz. The instruments' low self-noise, makes the data useful or local and regional seismic monitoring.

Certimus
A triaxial broadband seismometer with a flat frequency response between 120 s and 100 Hz. The Certimus has true broadband performance with a low instrument self-noise that makes it well suited for regional seismic monitoring. The Certimus is used globally for applications ranging from volcano monitoring to regional and national networks.

Combining Fortimus and Certimus provides an ultra-wide dynamic range

InSEA wet demo SMART cable

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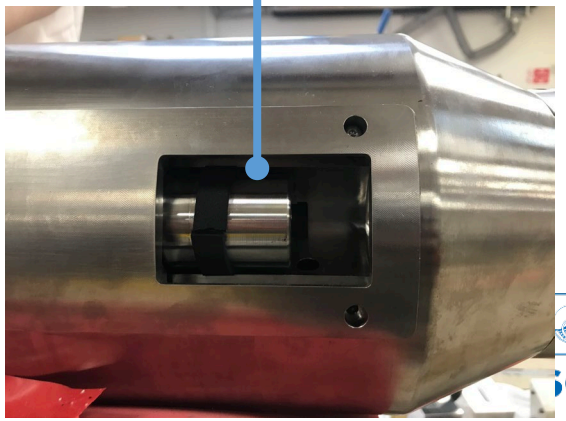
Instrument Pod

The **Seabird SBE 39Plus** and the **Paroscientific 8000 Series** are housed inside a titanium container called Instrument pod. Each instruments is isolated from pod by means of spacers. **Windows** put the instruments in contact with the external environment. The instrument pod could be deploy using **standard cable laying procedures**. The distance from the repeater is 30m.



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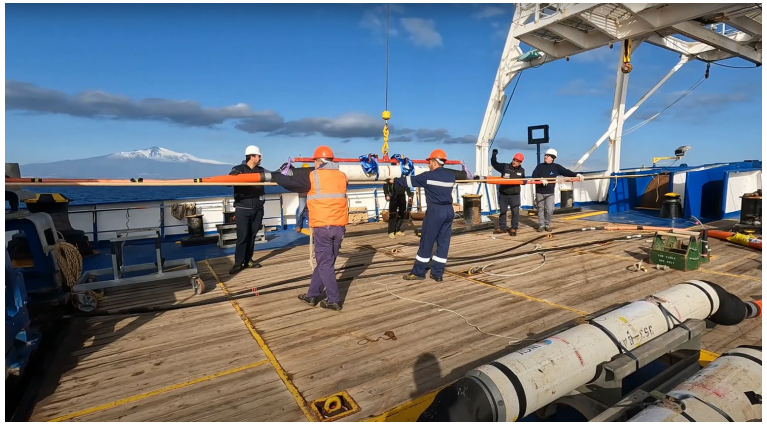
December 2023 installation



- Deployed using standard CABLE LAYING VESSEL and METHODS

Funded SMART Cables Systems

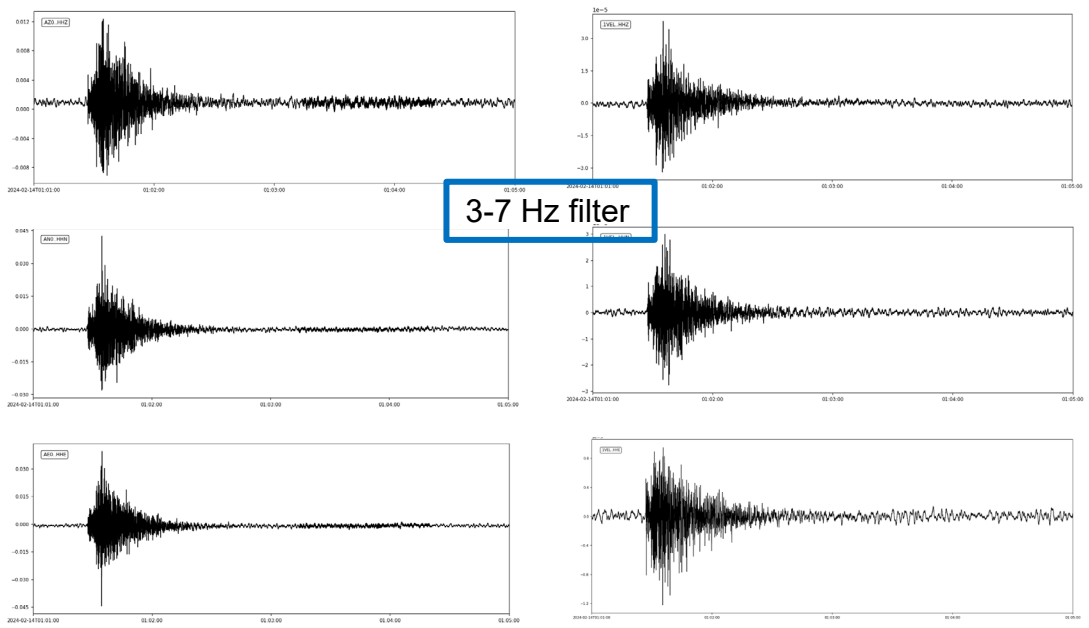
Video InSea wet demo SMART cable laying

Funded SMART Cables Systems

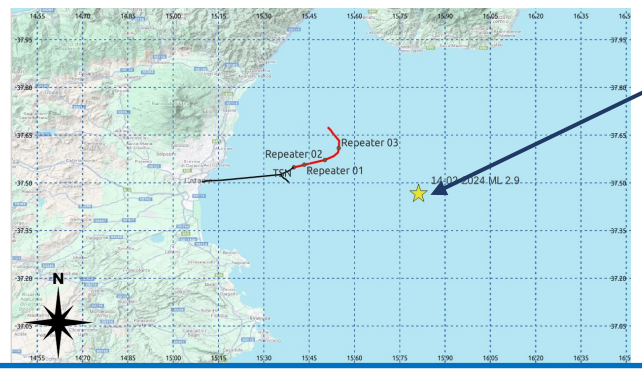
InSEA wet demo SMART cable: seismic data

CALIPSO observatory seismometer

SMART cable seismometer



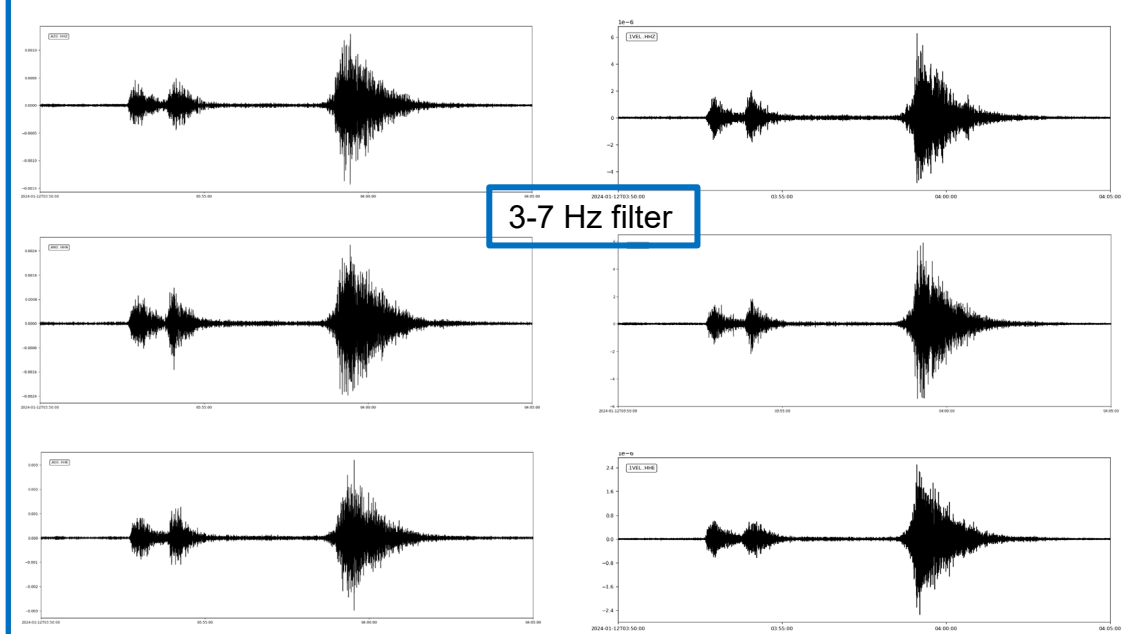
3-7 Hz filter



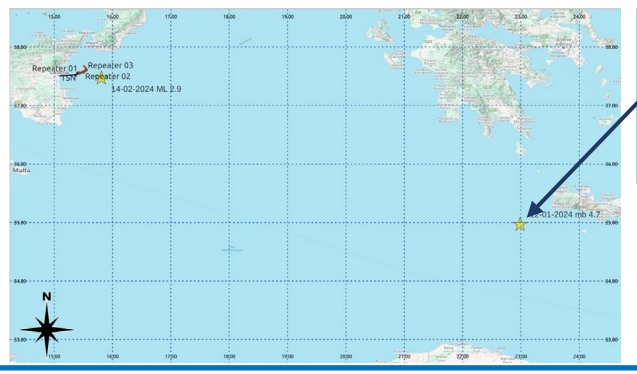
LOCAL EVENT ML 2.9
Ionian Sea
31 km depth
14-02-2024 01:01:17

CALIPSO observatory seismometer

SMART cable seismometer



3-7 Hz filter



REGIONAL EVENT mb 4.7
Greece [Sea]
20 km depth
12-01-2024 03:51:07

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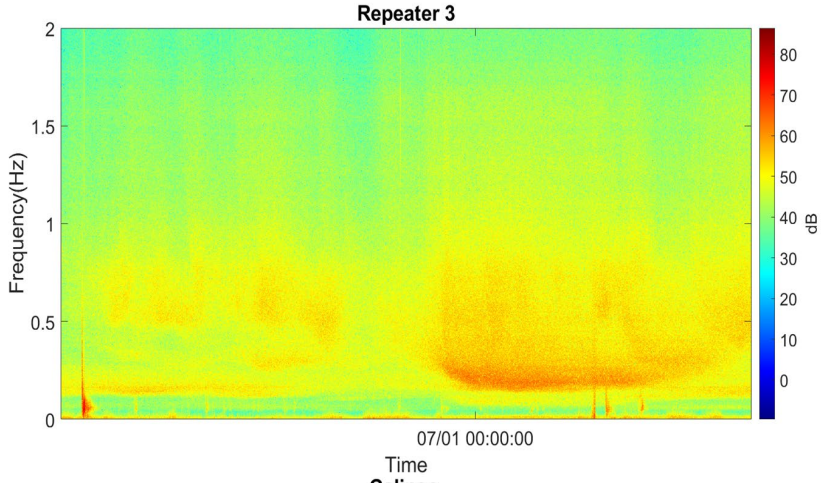
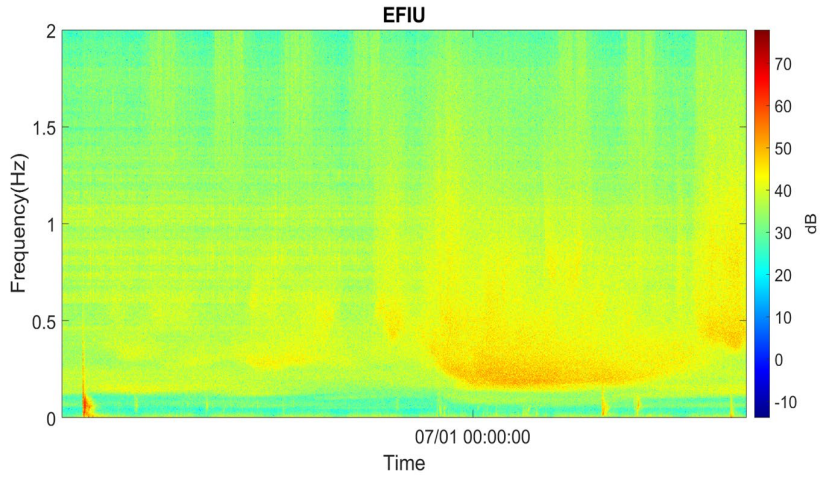
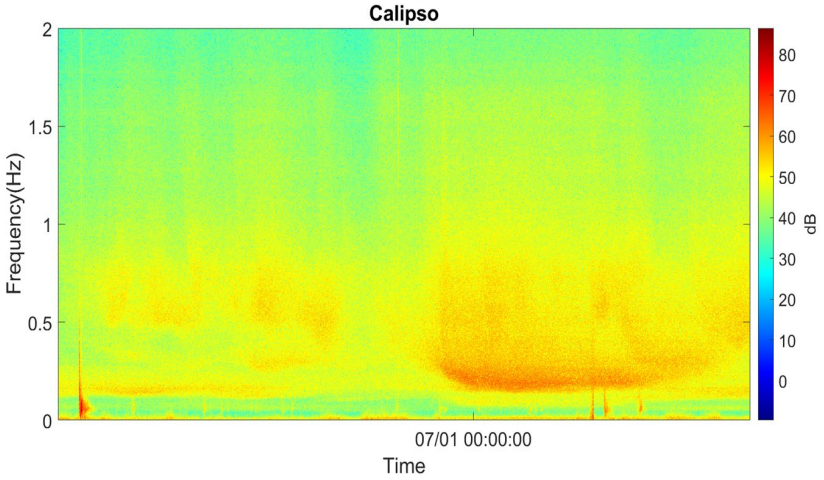
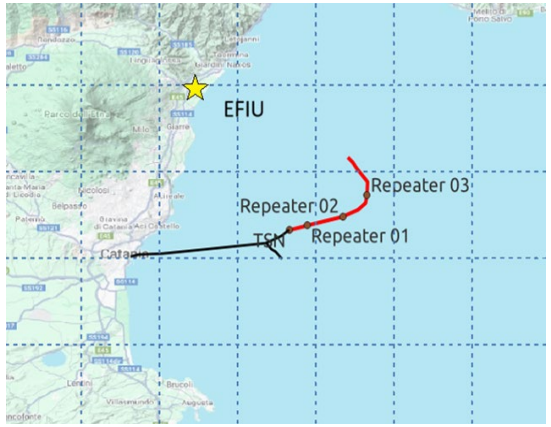
InSEA wet demo SMART cable: seismic data

Seismometers data 1-1-2024→10-1-2024 - spectrogram with 500s time window

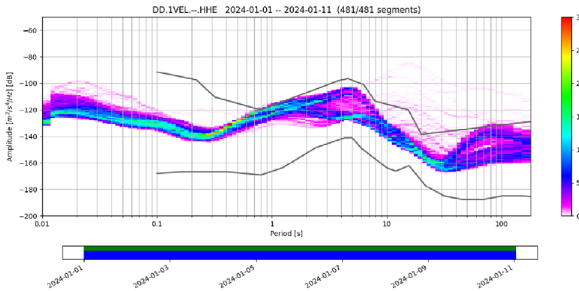






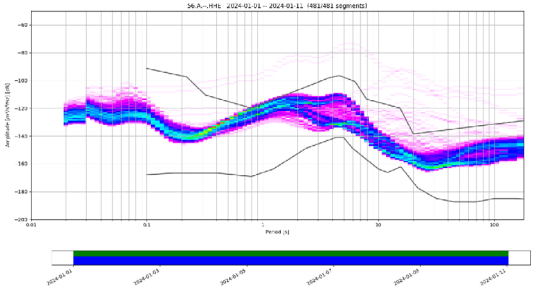


SMART cable PSD



SMART cable seismometer (CERTIMUS)'s ability to work at any angle combined with the engineering effort to ensure that the instruments were coupled with the repeater housing has resulted in good coupling with the seafloor.

CALIPSO PSD



CALIPSO observatory hosts ORCUS OBS, an observatory grade station that delivers high quality data for research applications.

InSEA wet demo SMART cable: temperature data

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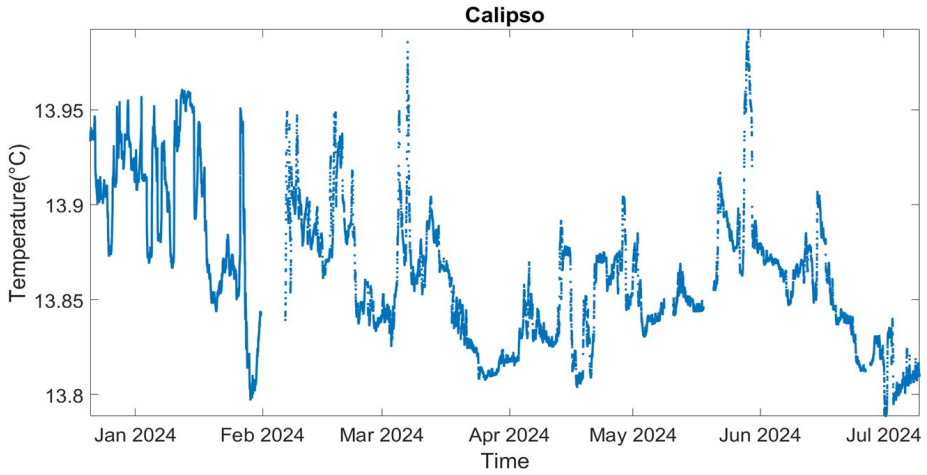
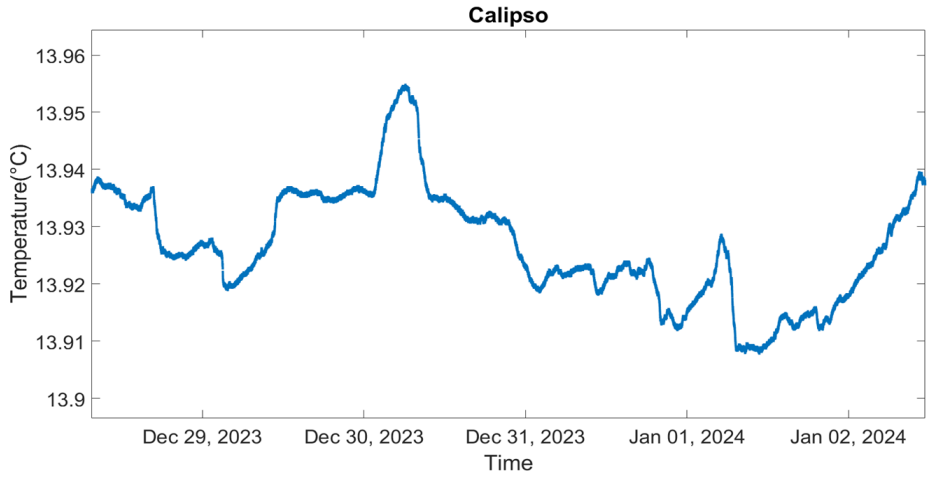
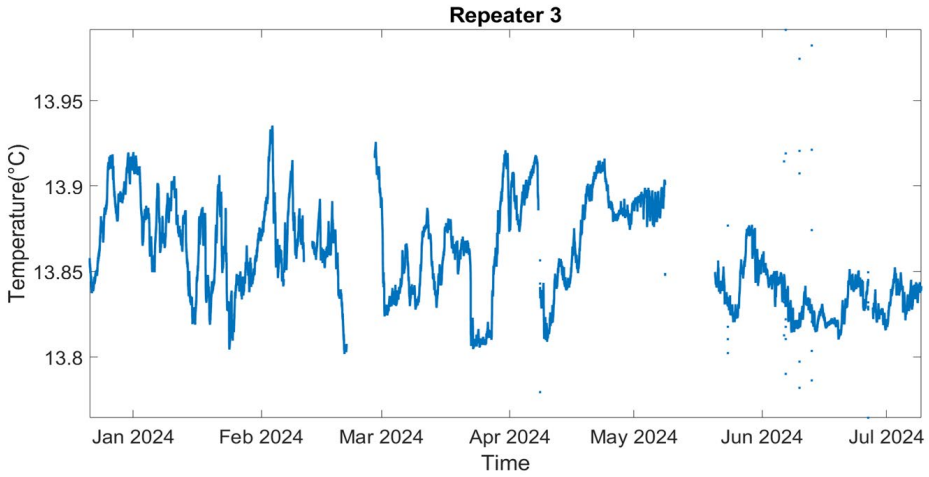
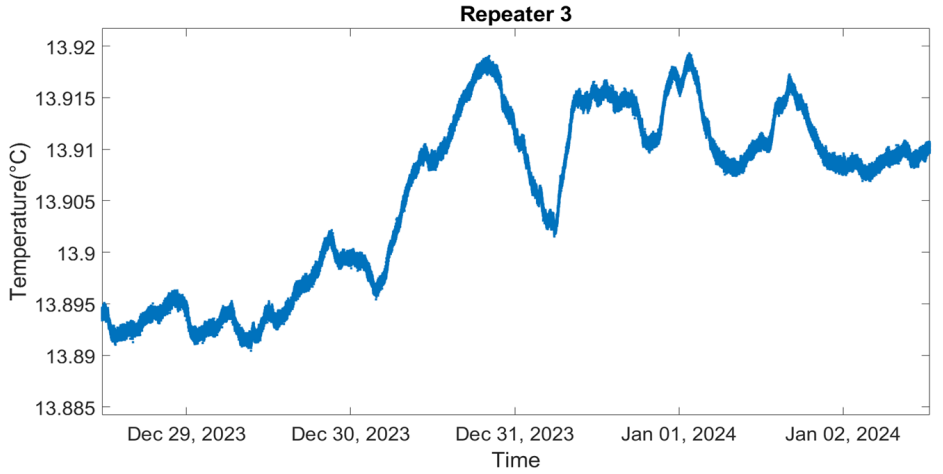
RAW temperature data 22-12-2023→7-7-2024



RAW temperature data 29-12-2023→2-1-2024







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InSEA wet demo SMART cable: pressure data

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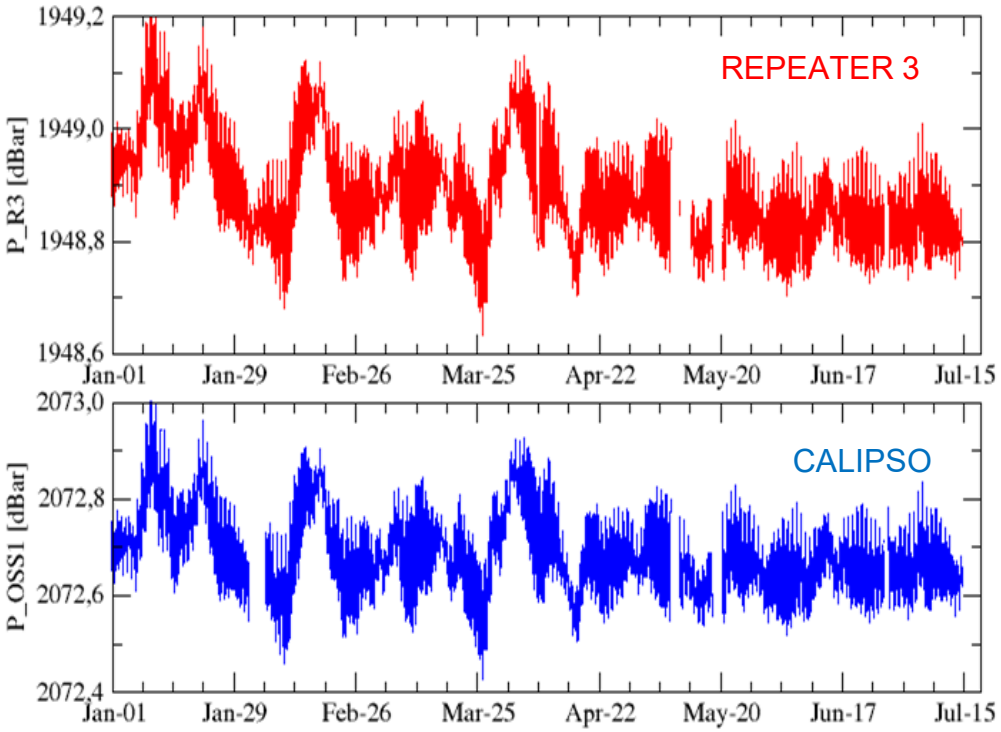
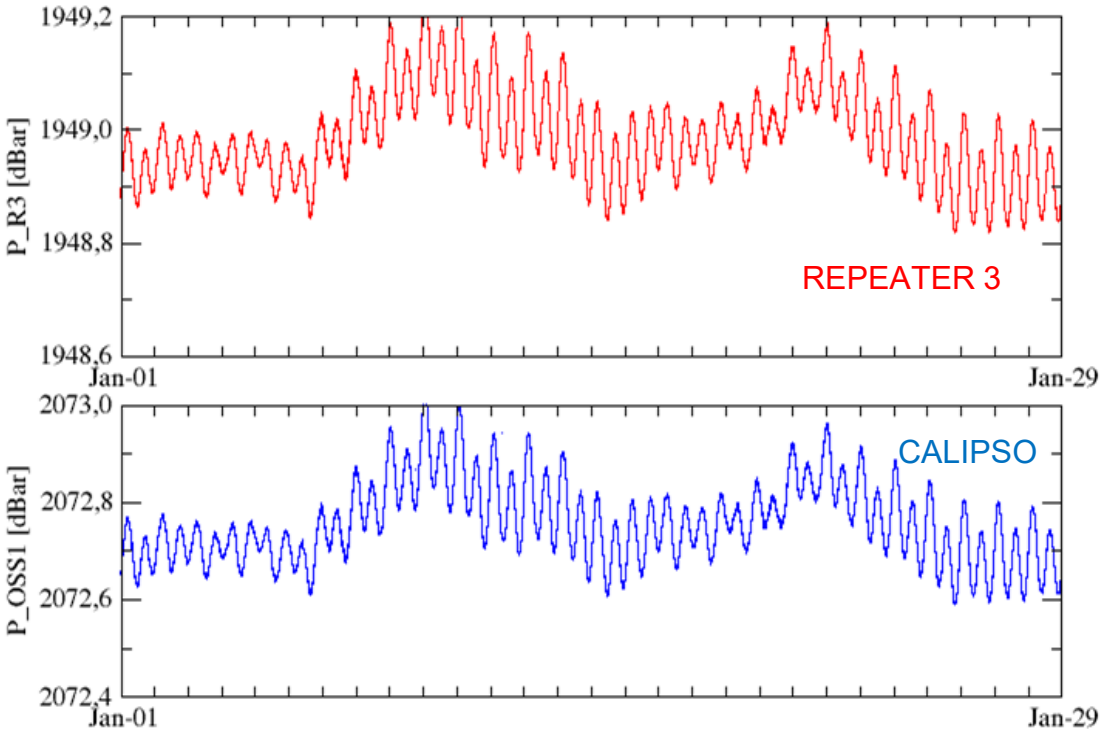
RAW pressure data 1-1-2024→15-7-2024



RAW pressure data 1-1-2024→29-1-2024



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InSEA wet demo SMART cable: data acquisition

Data from the 3 repeaters and T sensors are acquired by GURALP digitizer and transmitted to shore station.

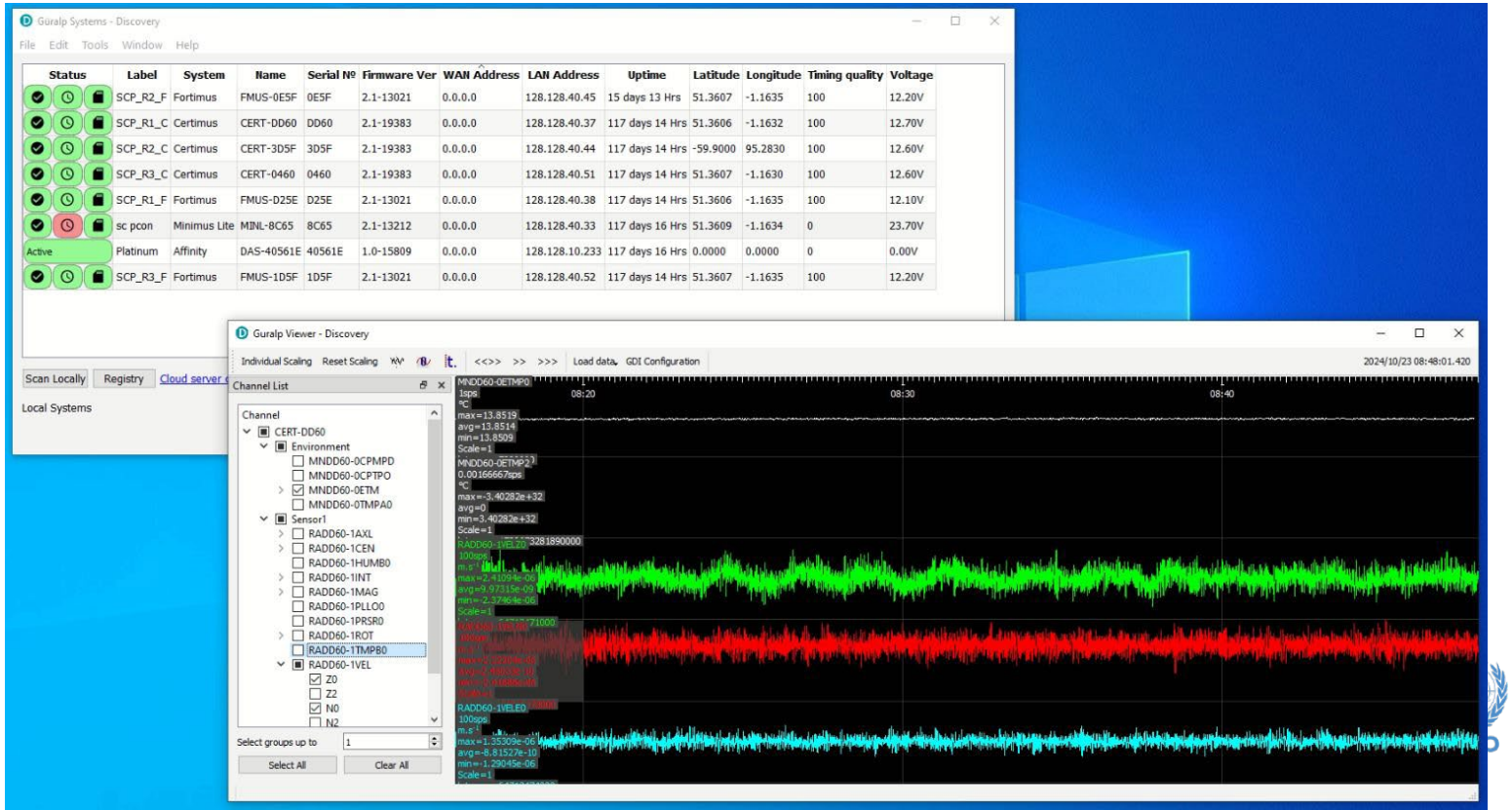
Pressure sensor directly provides the acquired data using an Ethernet connection through the repeater to shore station.

All data, except for pressure, are sent with a **timestamp** because the digitizers and the communication infrastructure are compliant with **PTP synchronization protocol**. Pressure data (sampled every 15 s) are time-stamped on shore.

On land **SCREAM!** GURALP software is in charge of creating and saving files from all the components of seismometers, accelerometers and temperature sensors.

The software manages internal status sensors like internal temperature, humidity, tilt, orientation, CTAi voltage and current.

All the files are transferred to the INGV data server with redundant storage.



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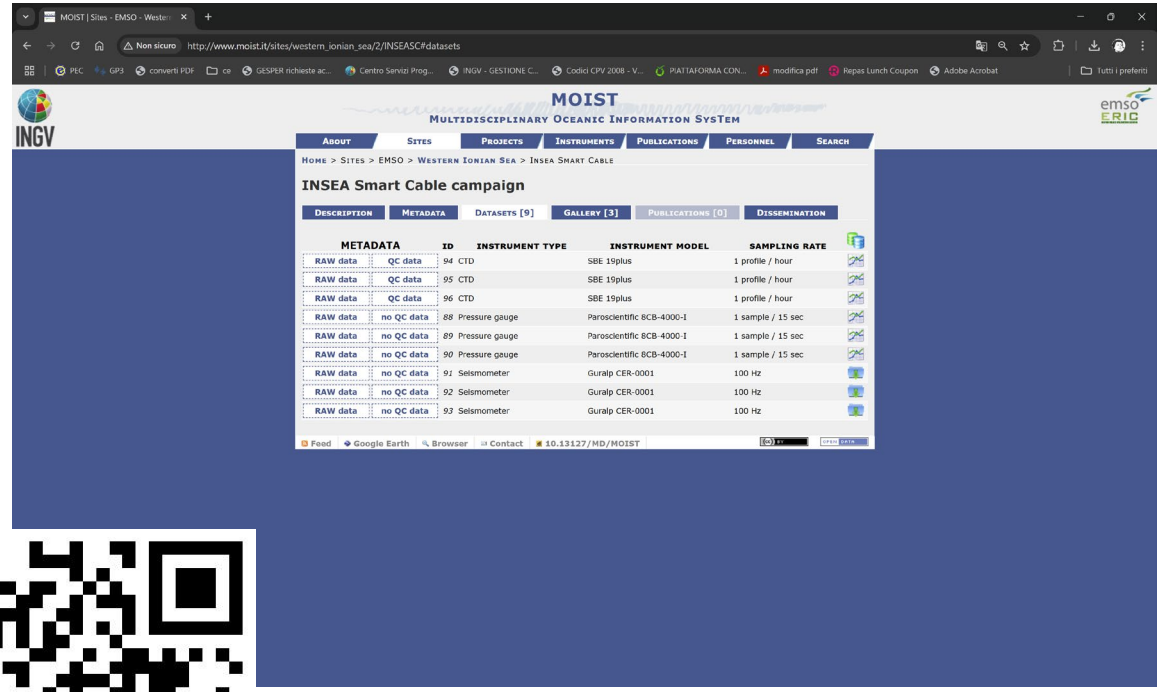
InSEA wet demo SMART cable: data release

Raw data are published on http://www.moist.it/sites/western_ionian_sea/2/INSEASC



Seismic data are acquired in proprietary GURALP format files (**.gcf**). For each repeater, one downloaded zip file contains the 3 components of the seismometer of one hour acquisition (@250 Hz for the first months and then @100 Hz).

Seismic data will be sent to EIDA in real-time in miniSEED format.

The **pressure** and **temperature** sensors data are collected separately in **plain text files** containing the time tag and the raw data (as sent by the instruments).

For each repeater it's possible to download:

Pressure – 1 single file (the entire dataset with 1 sample every 15 s)

Temperature – each file contains 4 hours of data (@2Hz for the first months and then @1Hz)

We are finalizing the process to include accelerometer and quality control data in our upcoming data release

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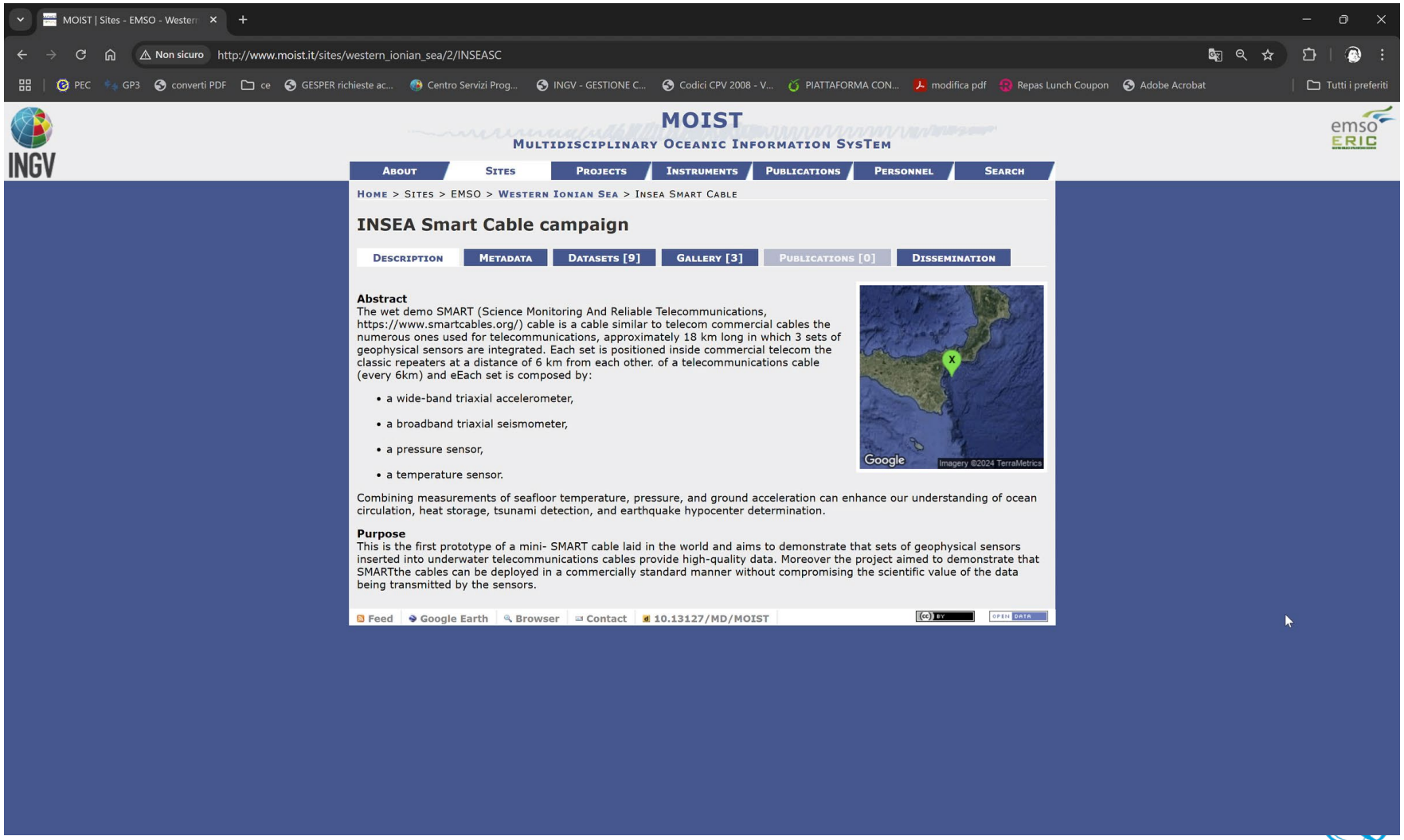
InSEA wet demo SMART cable: data discovery



InSEA wet demo SMART cable: results

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InSEA wet demo project has demonstrated that a science cable can be deployed by conventional methods.

Data quality is very high from all the sensors.

Unfortunately, we encountered a setback with the pressure sensors.
All three sensors have stopped transmitting readable data.
The last data points were received on March 14th, June 7th, and October 7th, 2024, respectively.
We are currently investigating the cause of this issue.

Despite this challenge, the wet demo remains a significant milestone.
It marks the first time scientific sensors have been integrated into a telecom cable in a deep-sea environment.

The SMART cable community can now look forward to a future of innovative ocean exploration and monitoring.

Thank you for you attention!

giuditta.marinaro@ingv.it

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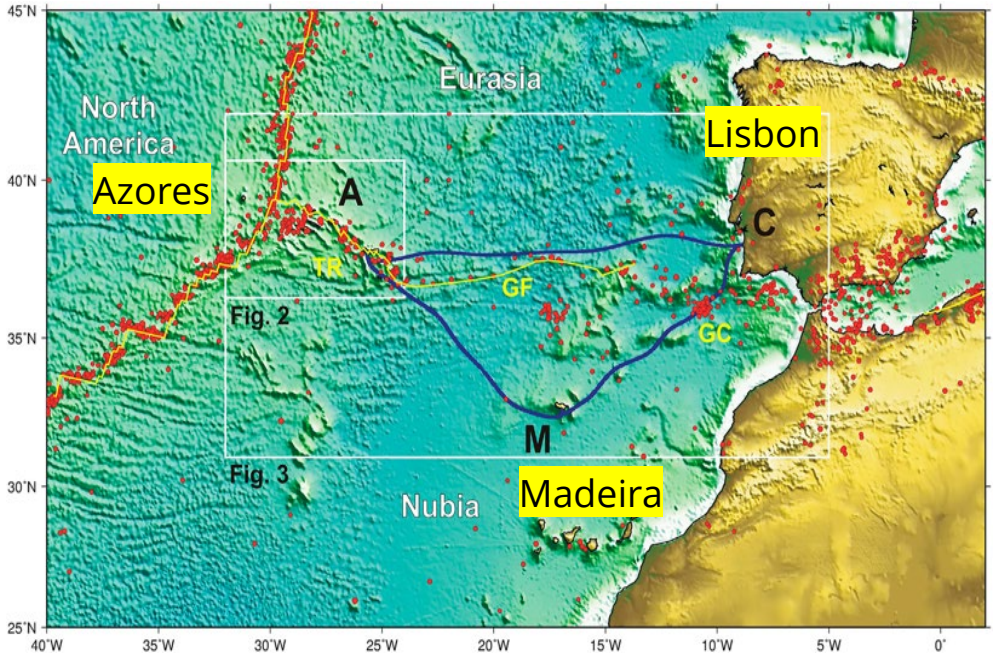
ATLANTIC CAM

Alberto Passos
Telecom Business Director
IP Telecom

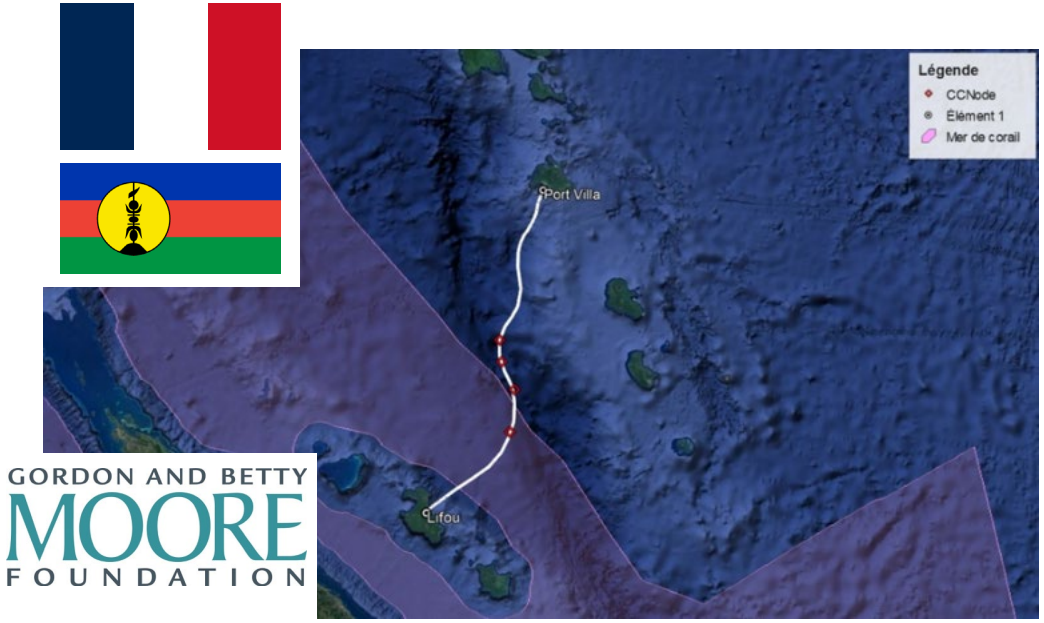


- 3700 km, ~20 SMART modules
- Gov't €154M. EU support €56M
- SMART 15% ➔ €22M ~ €2/citizen/25 y
- ~ 2 Tsunami buoys, 25 year (unreliable, no seismic, not real time)

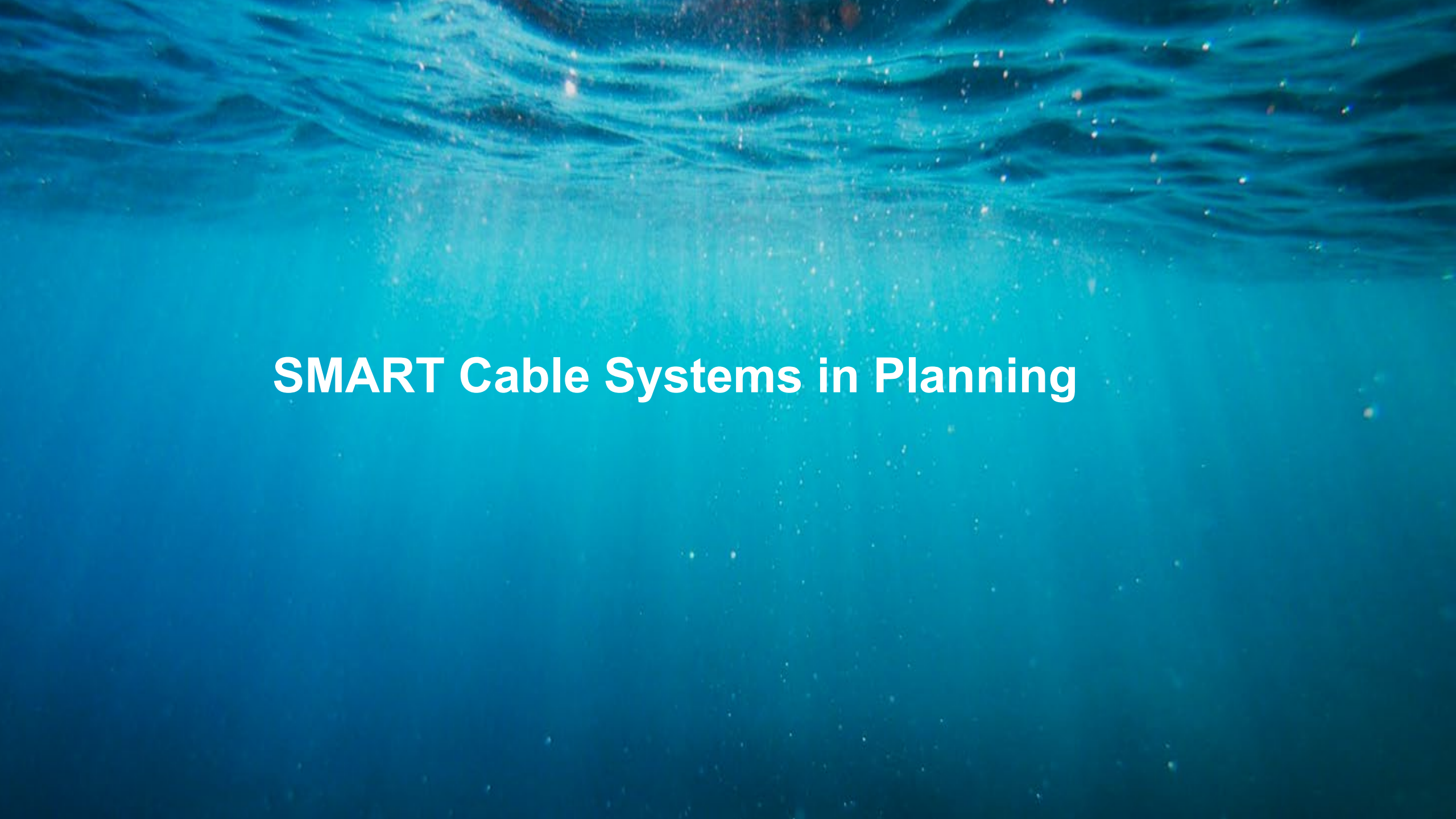
Funded SMART Cables Systems

TAMTAM

Martin Patriat
Researcher Lead
IFREMER



- 450 km long, 4 SMART modules
- France funding SMART (telecom: AFD, ADB)


SMART Cable Systems in Planning

Earth's Pulse SMART Cables in the Northern Hemisphere

ANACOM hosted the meeting “Earth's Pulse SMART Cables in the Northern Hemisphere”, jointly organized by **ANACOM (*Augusto Fragoso*)** and **JTF SMART Cables (*Bruce M. Howe*)**. This global event highlighted the ***importance and potential of submarine cables that goes beyond the transport of data and communications***, and opens a door to the future of monitoring essential oceanic variables (EOVs) with enormous socio-economic impact. With the integration of cutting-edge technology, particularly for seismic and oceanographic monitoring, “**SMART Cables**” can play an essential role in mitigating natural disasters, such as earthquakes and tsunamis, and make a decisive contribution to scientific research, particularly in global climate change and preserving ocean health. The conference also aimed to promote and strengthen international collaboration and discuss with different stakeholders new innovative technological developments and their potential applications, to contribute to improve global ocean monitoring and increasing the protection of coastal communities.

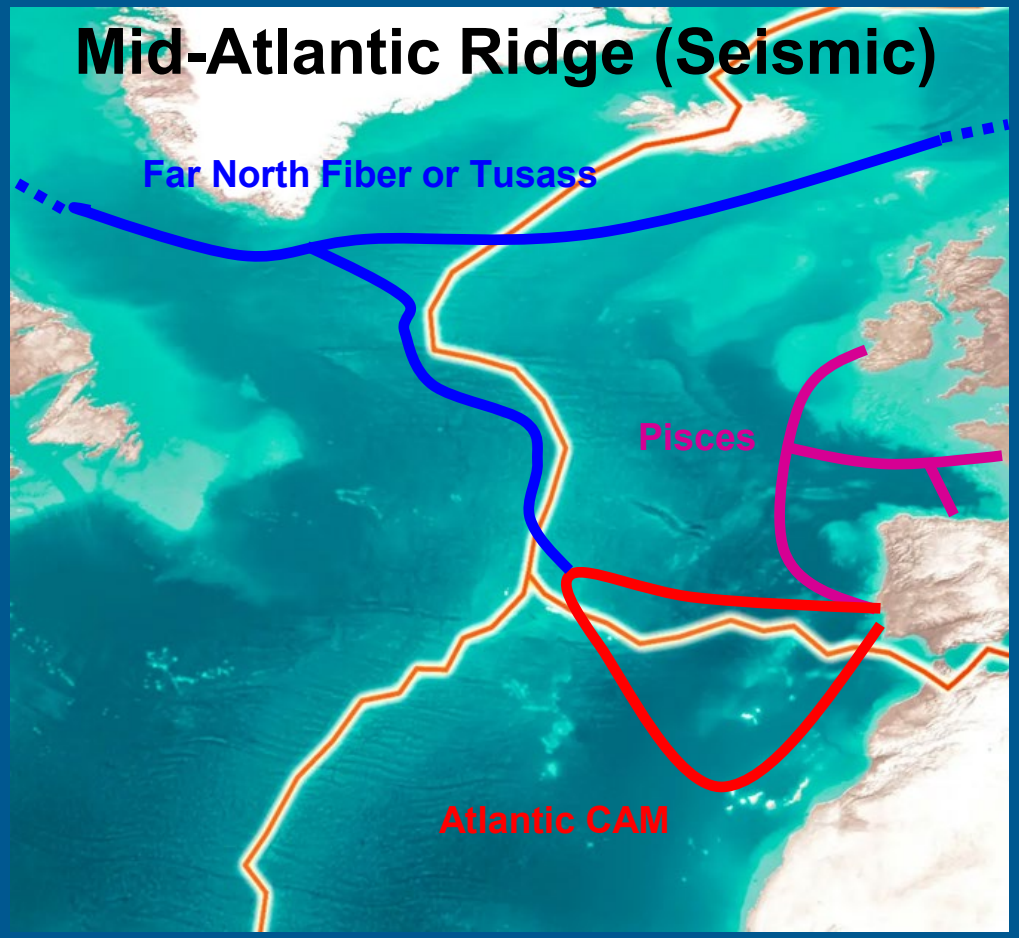
The panel of speakers included internationally renowned experts who presented ***innovative projects for the possible installation and use of SMART cables in the North Atlantic and other oceanic regions***, as well as novelties in technological developments in deep ocean sensing. The event also addressed **issues such as governance, data management and funding models for the expansion of these infrastructures**, in a context from regional basins to global oceans, with a demand for greater involvement of **GOOS,** as a new emerging network, supported by **IOC-UNESCO**

Future Systems in planning

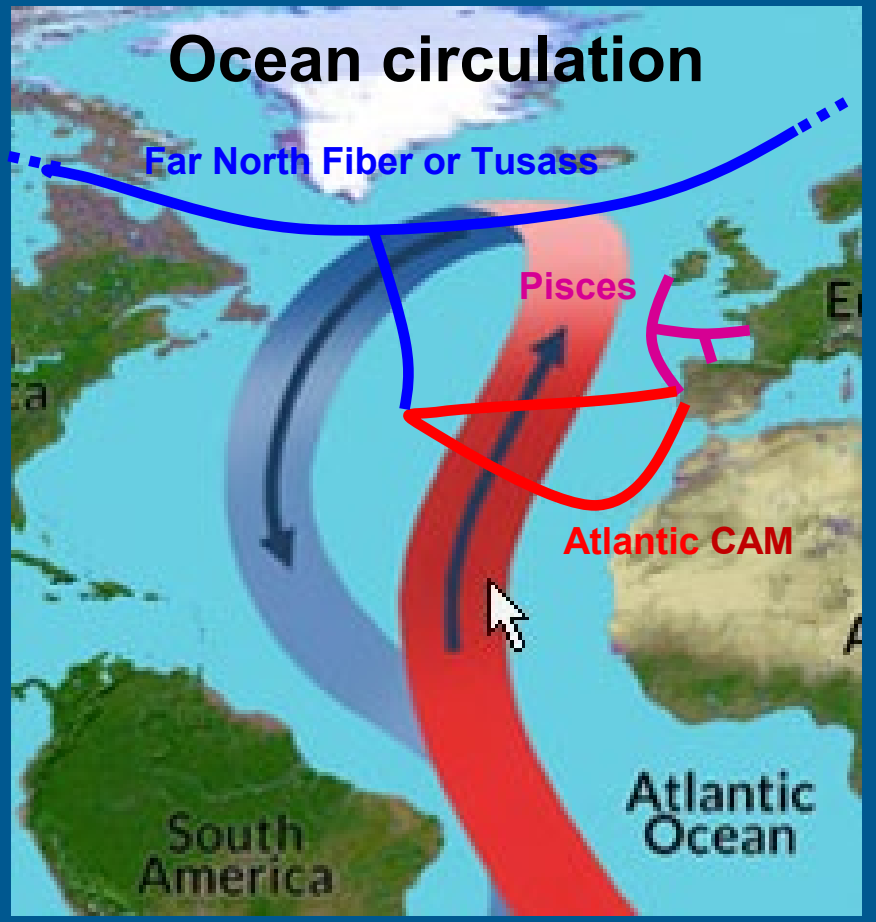
Successful meeting for the SMART Cable sector

- 70 in-person participants,
- plus 200 participants online
- 8 telecom companies and regulators
- Seismic network managers from Portugal and Spain
- Oceanographers and seismologists
- Ocean Observatories
- Data managers from Ocean Observing Systems
- European Commission staff from DG Connect
- ITU (International Telecommunication Union)
- IOC-UNESCO, GOOS

SMART Cables in the North Atlantic



Proposal for closing the gap in the North Atlantic by providing additional Environmental and Seismic Observation areas with Pisces and a branch for the Azores from Tusass or from Far North Fiber



SMART CABLES

SMART Cables monitoring the North Pacific, Arctic and North Atlantic

Closing the gap to the North Atlantic, having Far North Fiber with a branch to the Azores + Pisces as a SMART Cable.

Source: NORDUnet map

Systems:

- Polar Connect
- Far North Fiber
- Tusass
- Pisces
- Atlantic CAM

Earth's Pulse: SMART Cables in the Northern Hemisphere

SMART CABLES

Possible JTF SMART Cables members and others interested in the closing the gap to North Atlantic monitoring

Portugal: **ANACOM, FCCN, IP Telecom, IPMA, Air Centre, Hydrographic Institute, Universities**

Ireland: **Marine Institute (Galway), ERI, Government, McMahon Design, Universities**

Spain: **CSIC (UTM, ICM, IEO, IGME), IGN, SOCIB, ROA, PLOCAN, OBSEA-UPC, CIM, Universities, ...**

France: **IFREMER, IRD, IPGP, Mercator Ocean, Pacific Peering, Universities**

Italy: **INGV, CNR, OGS, Universities**

Denmark, Iceland, Norway, Sweden, Finland: **NORDUnet** (DeiC, RHnet, Uninett, SUNET, Funet)**, NORCE, MI-Bergen,** NORSK POLARINSTITUTT**, FMI- Helsinki, DTU Aqua, SWEDISH POLAR RESEARCH SECRETARIAT, SWERVE, Universities**

Greenland: **Tusass, …**

Germany: **AWI, GEOMAR,** Msc Marine Science Center - Robbenforschungszentrum Hohe Düne

FORSCHUNGSZENTRUM JÜLICH, ***Helmholtz-zentrum Für Umweltforschung*****, UFZ , UNIVERSITIES**

UK: **NOC, SAMS, Universities,**

US / Canada: **Far North Fiber, NSF, NOAA, ONC, Bedford Institute of Oceanography,** Institute of Ocean Sciences

EU: **DG Connect, DG Trade, DG Mare, EDA , External Action, EMSO ERIC, EuroArgo ERIC, ICOS ERIC, EMODNET, COPERNICUS …**

Int'l Organizations: **Other RENs, OSNAP AMOC Project, ITU, WMO, UNESCO-IOC, GOOS,**

Antarctic Chile Cable

Matías Sifón
Head, Oceanography
SHOA

NSF Antarctic Cable

Scope of Present Work

Presented by Patrick Smith, NSF GEO/OPP

❖ **Global Broadband Solutions, LLC (Leesburg, VA USA)**

- Two-year contract ends 15 Oct 2025

❖ **Tasks:**

- Solicit research community input for science objective alignment; sensor TRL; sensor placement location; Interest in partnerships; Interest for Follow-on Science Workshop
- Conduct Analysis of Alternatives & Report on community input
- Continue market research for risk reduction assessment
- Create a draft Project Execution Plan
- Develop Requirements for Marine Route Survey

NSF Antarctic Cable

Priority Near Term Work

❖ Research Community Input

- Request for Information (RFI) posted on U.S. Federal Register on 28 Aug 2024
- Closing date of 5 Nov 2024 now extended to 15 January 2025
- Data collection by on-line questionnaire (Survey Monkey)
- **Spread the Word – International input welcomed!**

❖ Links

Federal Register :: Request for Information (RFI) on Science Research Goals/Objectives Affecting Proposed U.S. Antarctic Science Monitoring and Reliable Telecommunications (SMART) Cable and Route Design

Website for supplemental information: Antarctic Subsea Science and Telecommunications Cable | NSF - National Science Foundation

Public Edition, Desktop Study: Connecting the Last Continent: New desktop study on Antarctica's potential subsea telecommunications cable | NSF - National Science Foundation

June 2021 Science Workshop Videos and Final Report: Antarctic Cable – Polar Geospatial Center

DISCUSSION

Closing Remarks

Mike Constable
Vice-Chair
JTF SMART Cables

SMART CABLES

ITU/WMO/UNESCO-IOC
JTF SMART Cables
Plenary Call
November 6, 2024

SMARTCables.org

ITU/WMO/UNESCO IOC Joint Task Force

Scan to Join!