UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-TEWS Hawaii)
TSUNAMI EARLY WARNING SYSTEMS
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME
15-26 September 2025, Honolulu, Hawaii

Improving Tsunami Warning - Emerging Tools and Technologies: ITU/WMO/IOC SMART Cables for Observing the Ocean

Ceci Rodríguez Cruz
JTF SMART Cables Initiative
International Programme Office
University Hawai'i at Mānoa

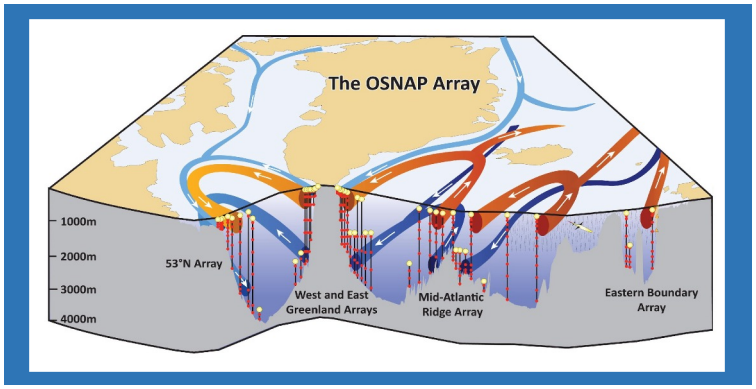
What are SMART Cables and Why do they matter?

SMART Cables integrate sensors into submarine telecommunications cables to measure seafloor temperature, pressure, and seismic motion (SMART modules)

Advancing Climate and Ocean Monitoring

Continuous, long term data for:

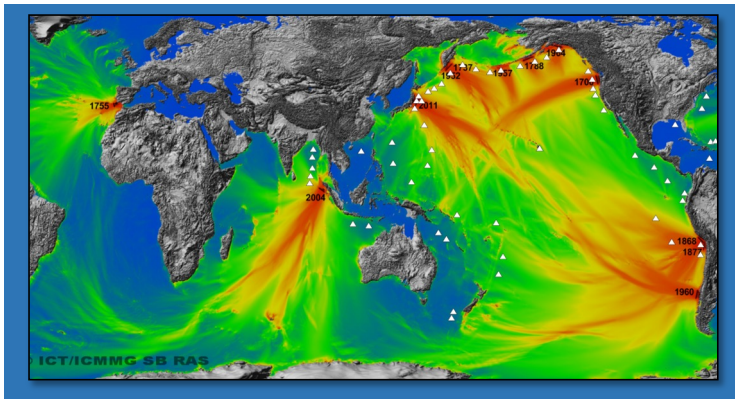
- Ocean heat content
- Sea Level Rise
- General ocean circulation



Improving Disaster Risk Reduction

Real time data for:

- Earthquakes
- Tsunamis



ITU/WMO/UNESCO-IOC JTF SMART Cables

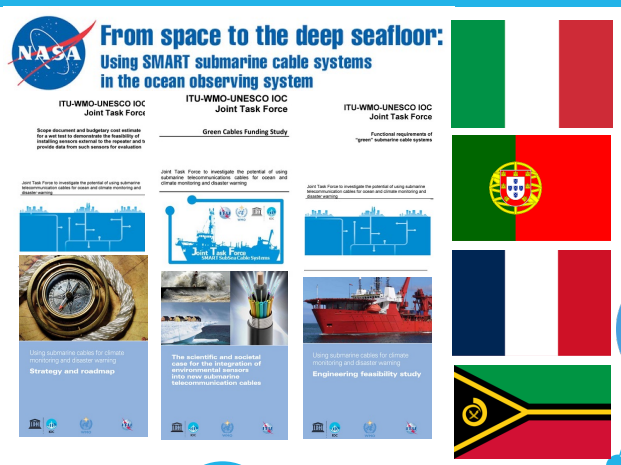

Malcolm Johnson


John You


Scholl Reinhard


Wenjian Zhang


Thorkild Aarup



2011
CONCEPT

2016
FOUNDATIONS

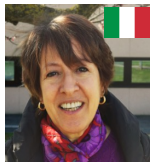
2020
COMMERCIAL AVAILABILITY

NOW
"MOMENTUM"

GOAL
SMART CABLES GLOBAL NETWORK


Bruce Howe


Chris Barnes


Laura Beranzoli


Jose Barros


Jerome Aucan

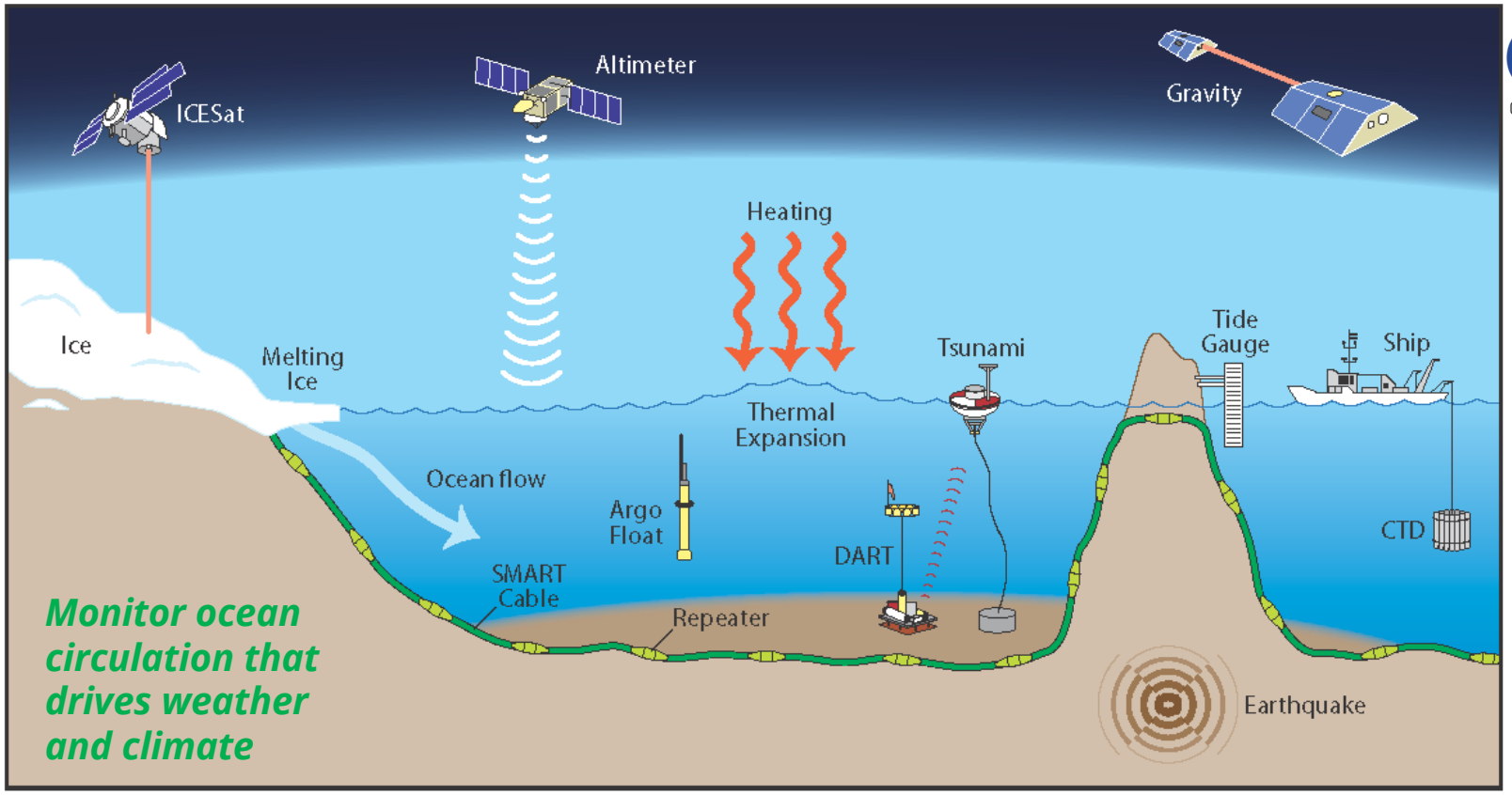
güralp

SubConnect

European Commission

ADB

Ocean + Climate change – Long term Observation



Global Ocean Observing System

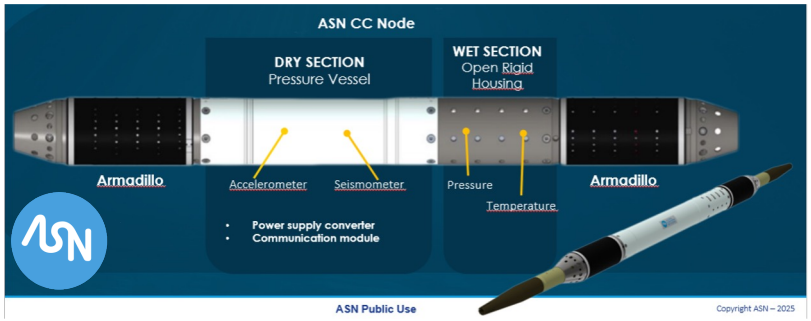
SMART Cables measure Essential Ocean Variables:
Temperature, Pressure; Seismic motion + …

SMART Capability

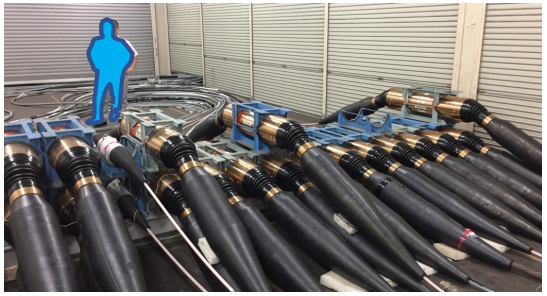
Shared Cable Infrastructure: Telecom + Science

No Interference

Repeater



Existing Technology



güralp Global Marine SUBSEA DATA SYSTEMS PACIFIC PEERING we connect islands

Sensors:

- Temperature
- Pressure
- Seismic

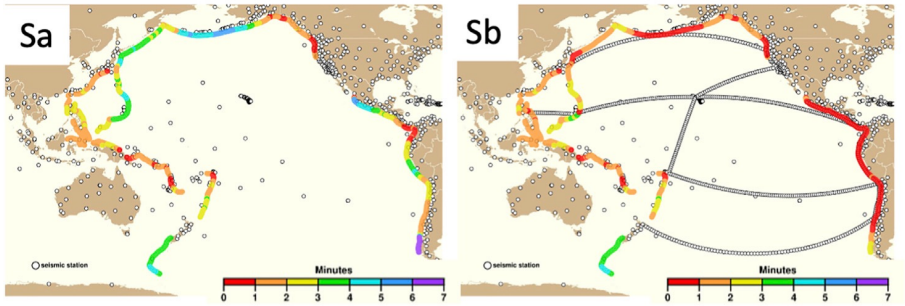
Key point:

- Essential Ocean Variables, Global Ocean Observing System

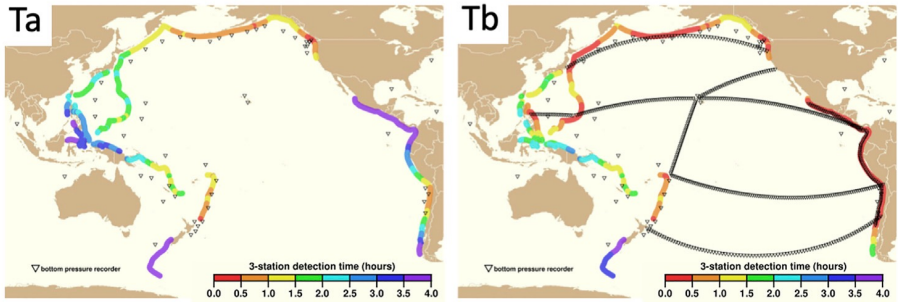
ITU unesco WMO

Earthquake and Tsunami Warning

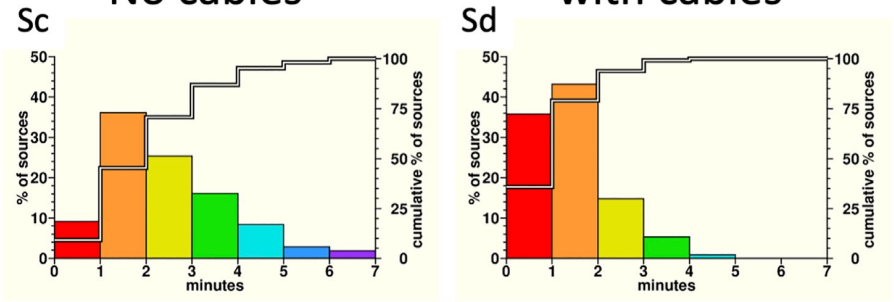
Seismic



Tsunami

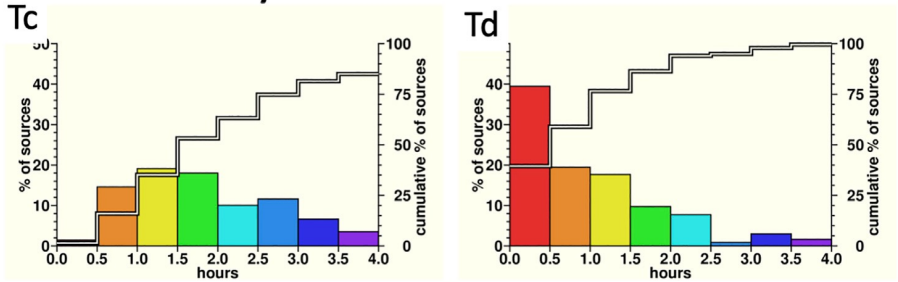


No cables / with cables



0 - 7 minutes

BPR only / with cables



0 - 4 hours

Simple travel time calculations, assumed source locations (trenches)

Nate Becker, PTWC

Earthquake detection time reduced
2.44 to 1.42 min, ~42%.

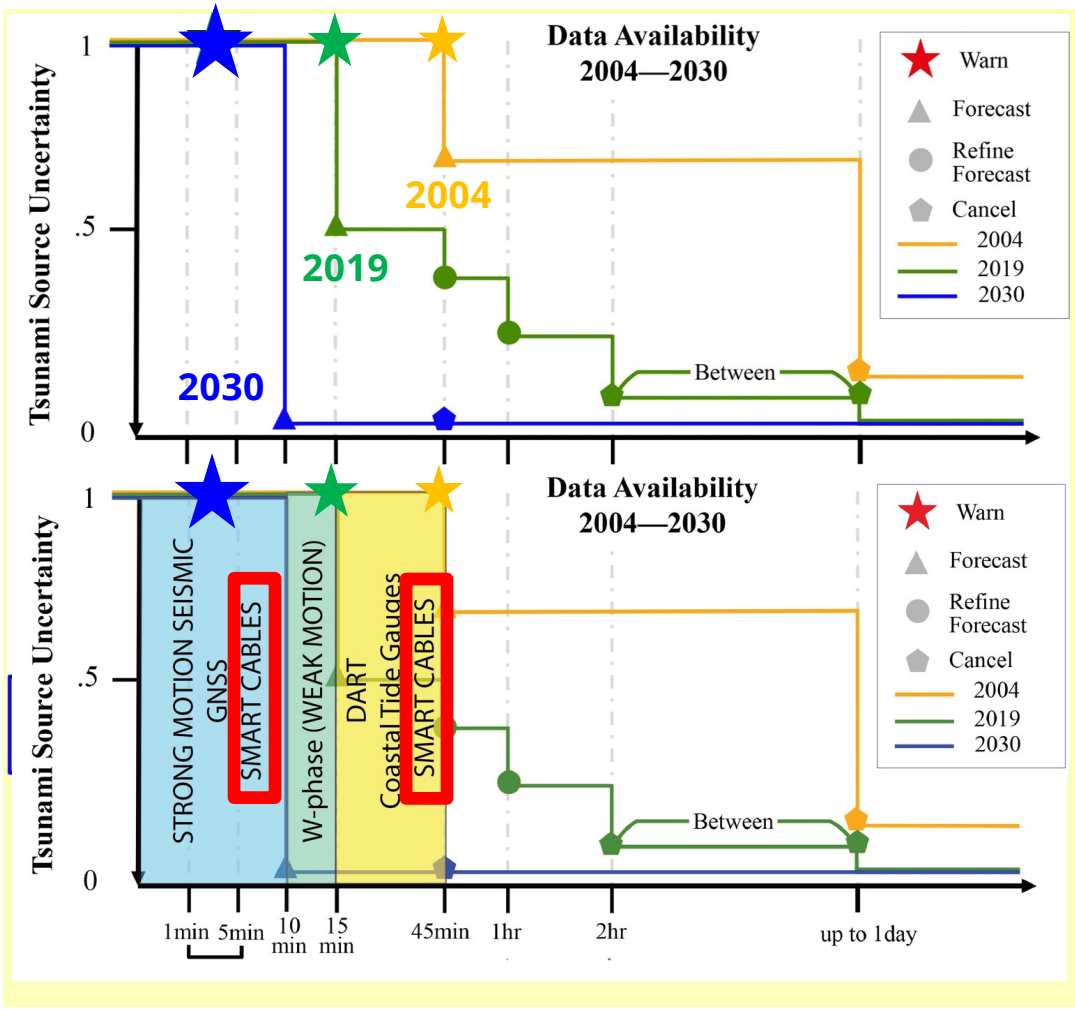
Time dropping from
2.4 to 1.0 h, ~ 57%

Improvement in Early Warning (SMART, GNSS)

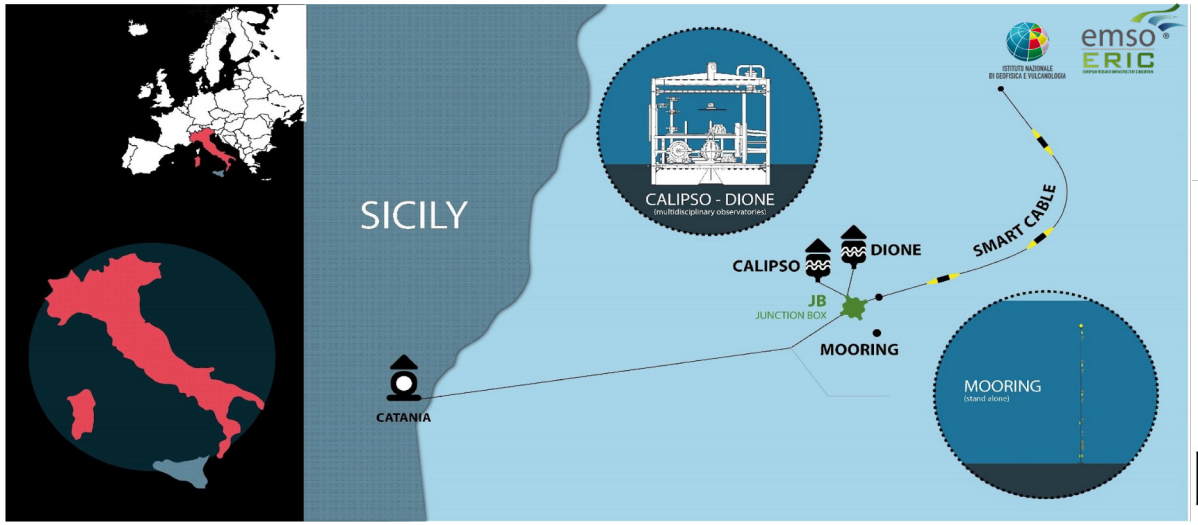
UN Ocean Decade Goal:

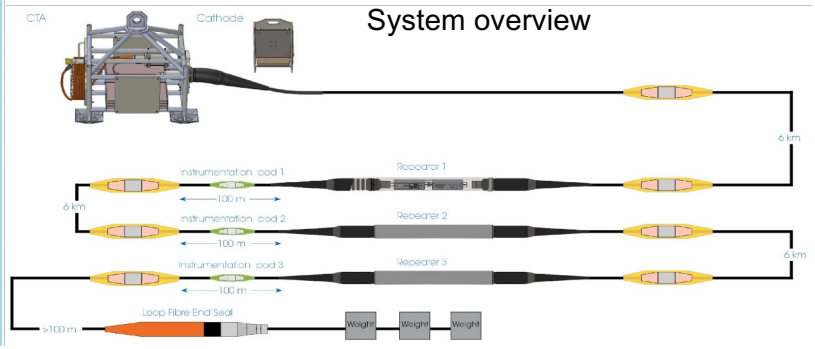
Integrate SMART Cable technology into innovative early warning systems

2021 2030 United Nations Decade of Ocean Science for Sustainable Development



InSEA wet demo SMART cable



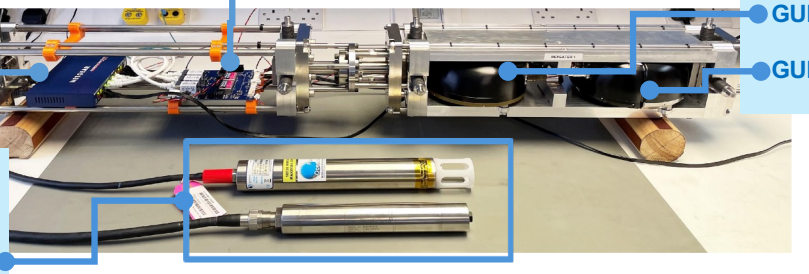


Communication and timinig:

Power:

Repeater:

- GURALP Fortimus
- GURALP Certimus



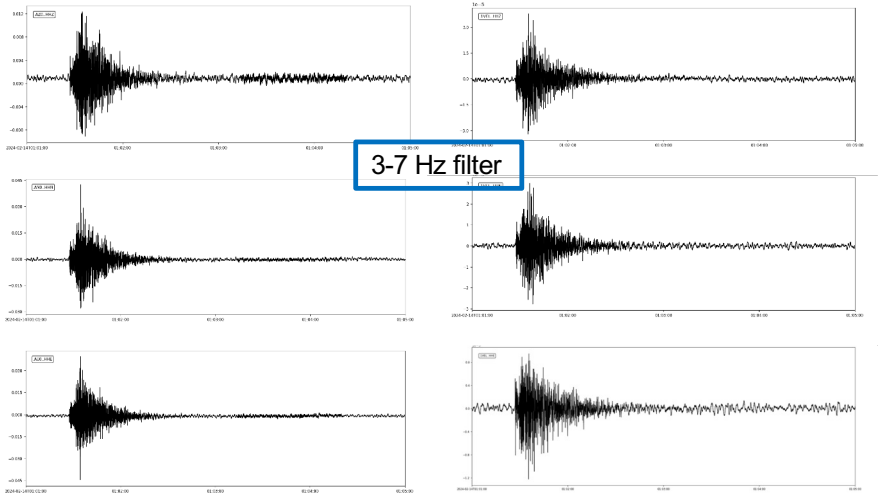
Instrument pod:

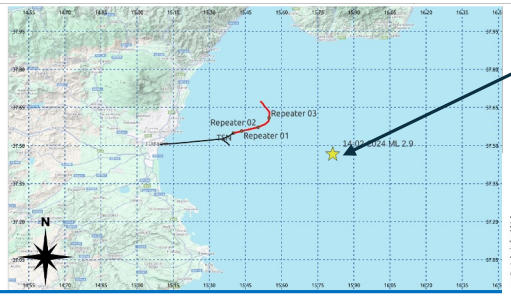
- Seabird SBE 39Plus
- Paroscientific 8000 Series

InSEA wet demo SMART cable

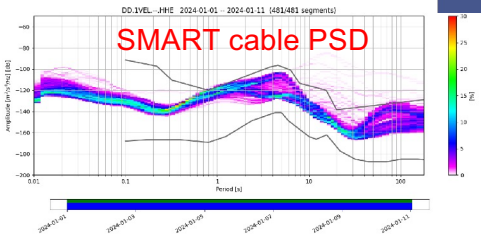
CALIPSO observatory seismometer

SMART cable seismometer

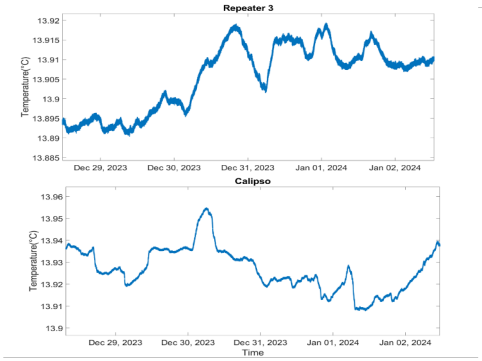




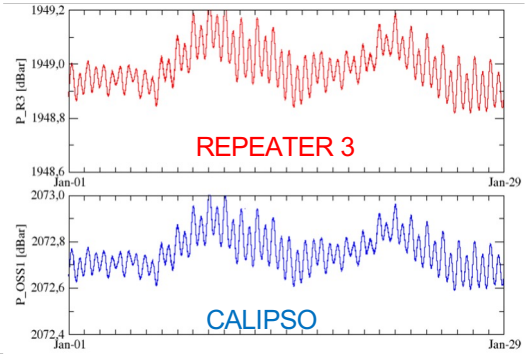
LOCAL EVENT ML 2.9
Ionian Sea
31 km depth
14-02-2024 01:01:17

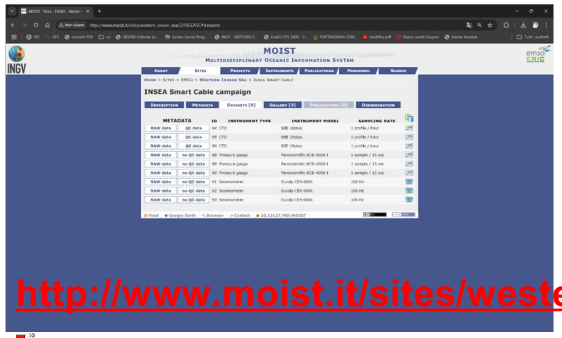


temperature data 29-12-2023 2-1-2024



pressure data 1-1-2024 29-1-2024





http://www.moist.it/sites/western_ionian_sea/2/INSEASC

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

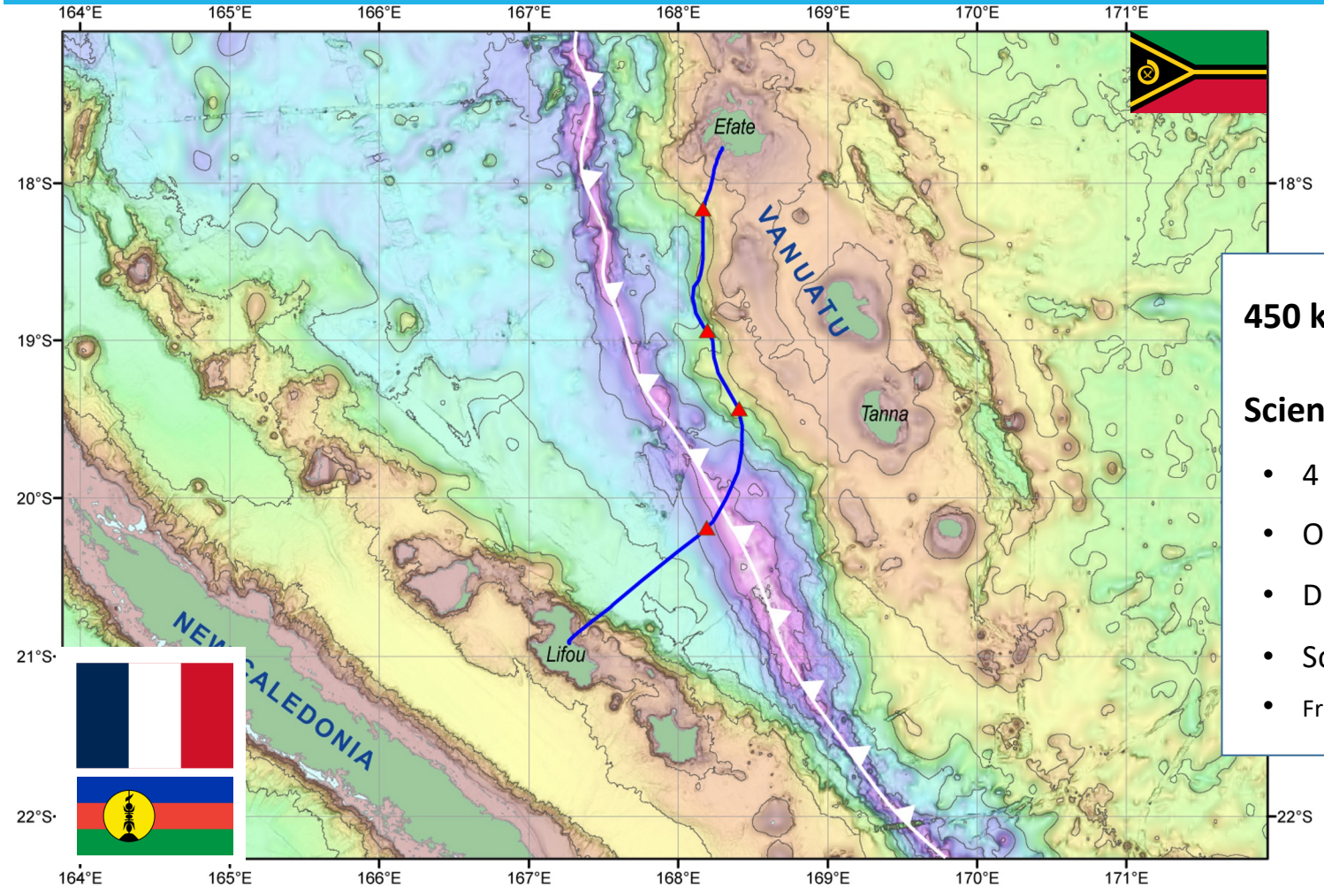
güralp

ITU

unesco

WMO

Tamtam SMART Cable System



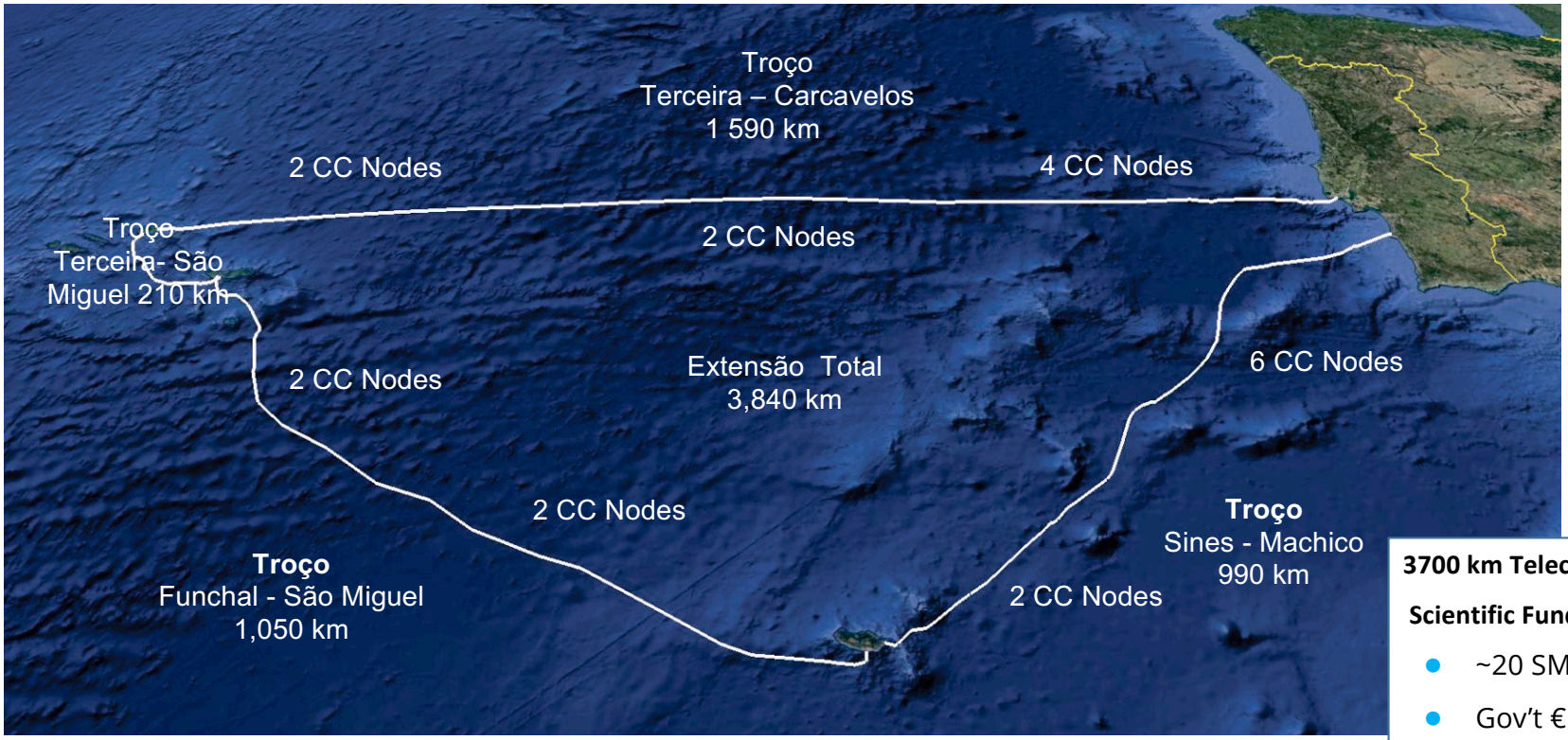
450 km Telecom Cable

Scientific Funding :

- 4 SMART « CC-nodes »
- Other sensing techniques
- Data Center
- Scientific Research
- France + ADB

Infraestruturas de Portugal

Atlantic CAM
Physical Layout



3700 km Telecom Cable

Scientific Funding :

- ~20 SMART modules
- Gov't €154M. EU support €56M
- Other sensing techniques

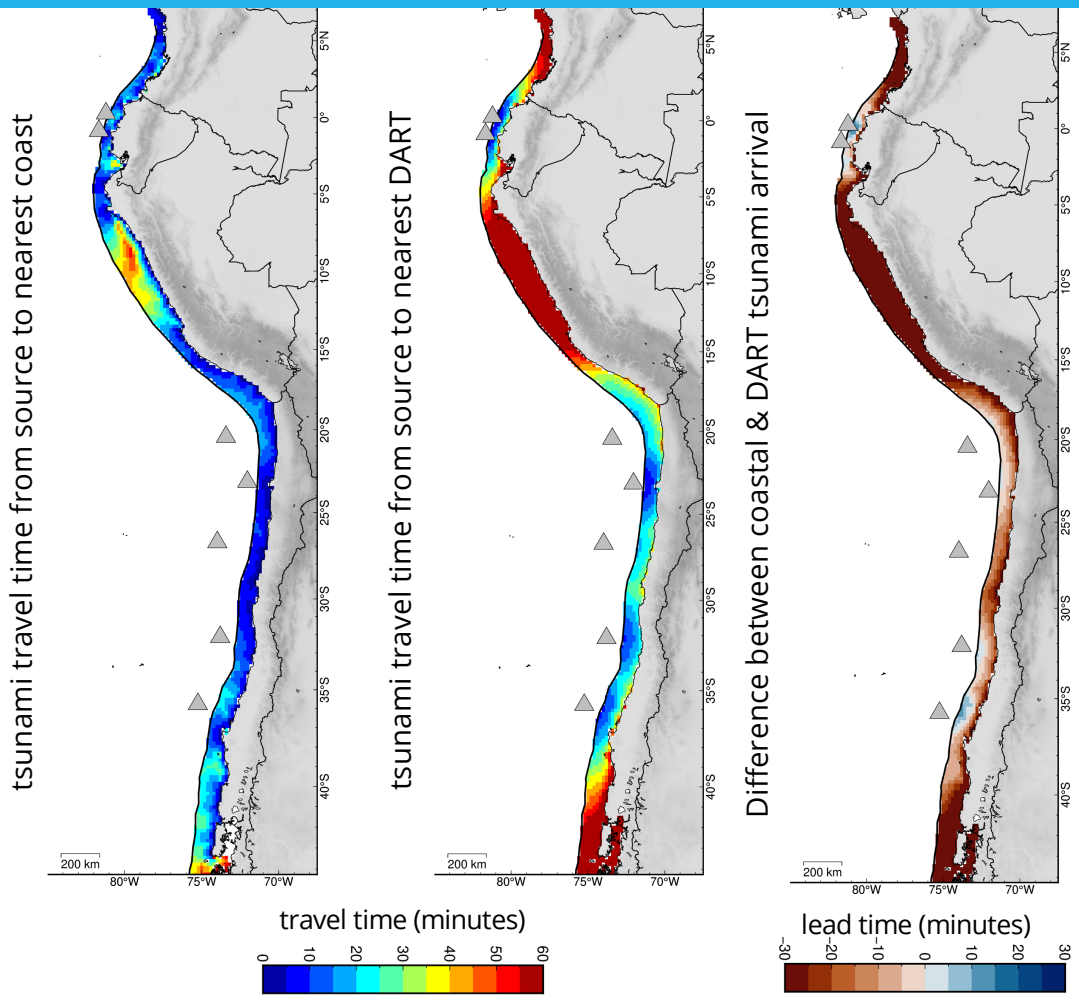
GT-ATPS Report

Capabilities for the evaluation of the threat of tsunamis for members of GT-ATPS and the exploratory proposal of opportunities and challenges for the incorporation of SMART cable technology. 2022

… implementation of oceanographic sensors in new underwater telecommunications cables, under the SMART concept (Scientific Monitoring and Reliable Telecommunications), is a promising solution to obtain a greater amount of data in real time that is essential to understand and manage urgent environmental issues such as climate change and the effects of tsunamis. Such sensors can provide important environmental data from sites in the deep ocean that would otherwise be difficult and expensive to obtain in real time and over large time scales.

English version not yet distributed by IOC

Why now - South East Pacific Region?



There are observational gaps in the present Seismic and tsunami sensor network

Regions like South America have limited time (< 15 min) between tsunami generation and arrival at the nearest coast

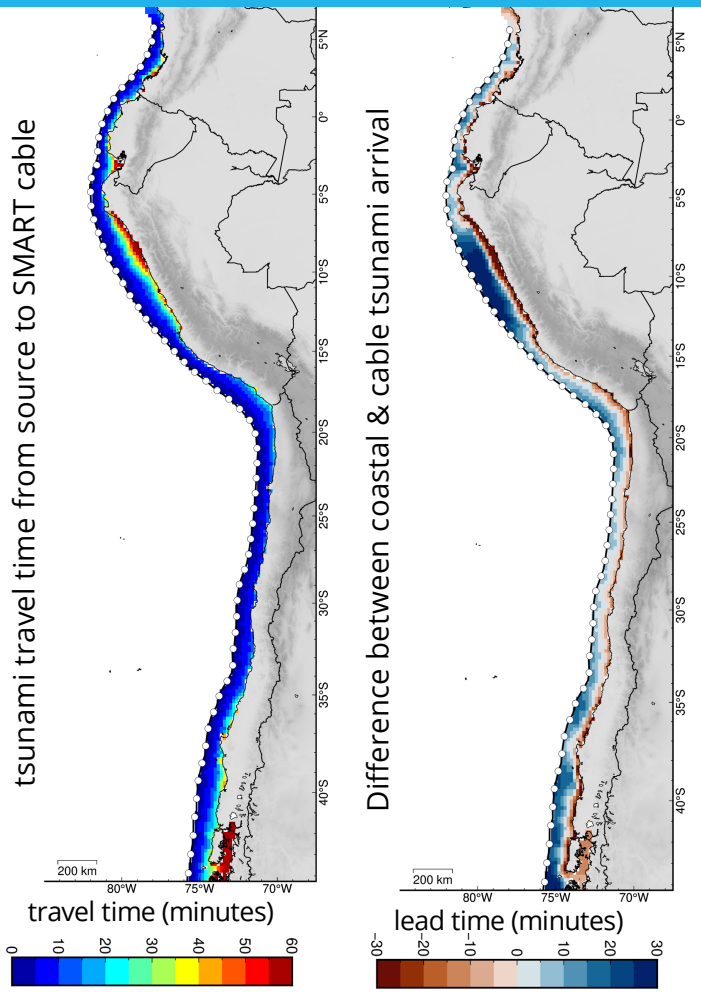
It takes too long for current tsunami networks to be of use for near-field warning

Lead time (between detection and nearest coastal tsunami arrival) is often negative

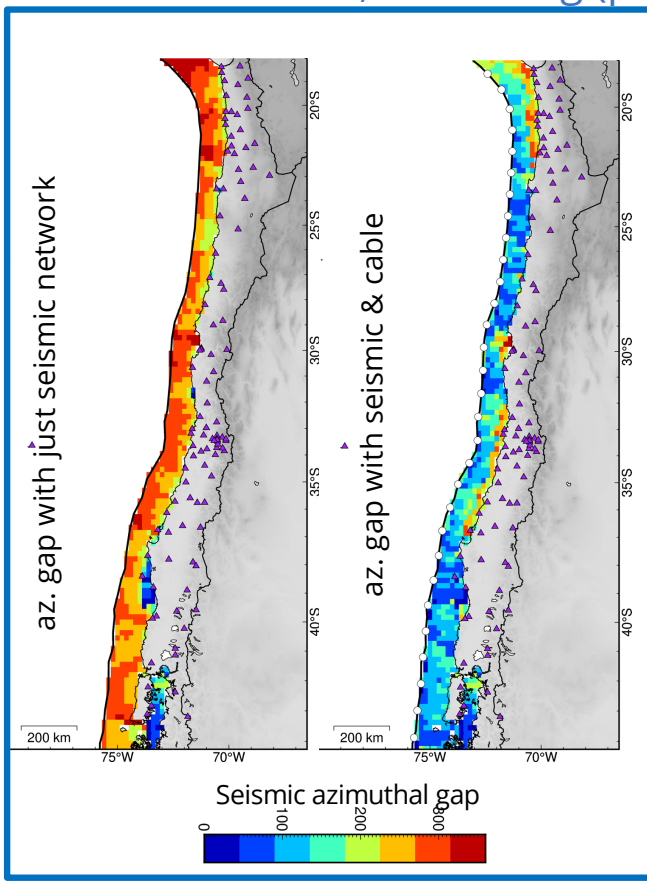
amy.williamson@berkeley.edu

Berkeley Seismology Lab

Why now - South East Pacific Region?



A SMART cable just seaward of trench (left) decreases the time to detection, increasing (positive) lead time.



The addition of offshore seismic stations reduces both detection time and azimuthal gap for initial earthquake location estimates.

SMART seismic and tsunami sensor cable network fills an observational gap for real-time earthquake and tsunami early warning

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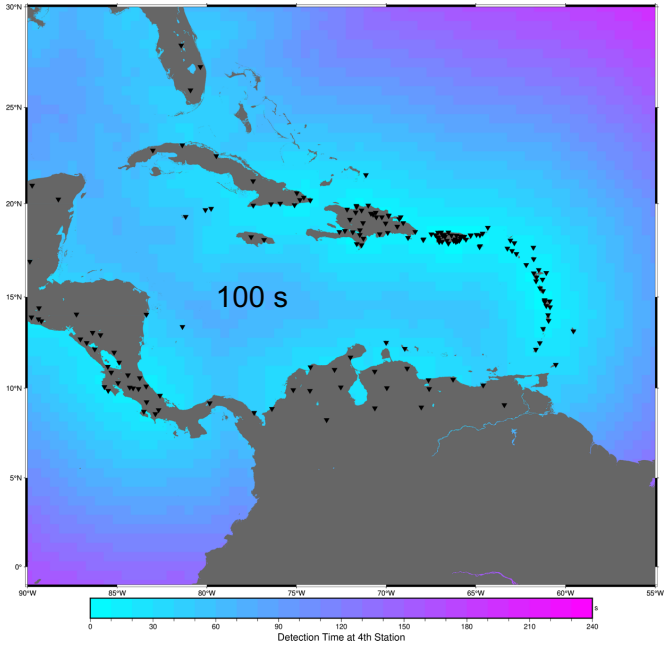
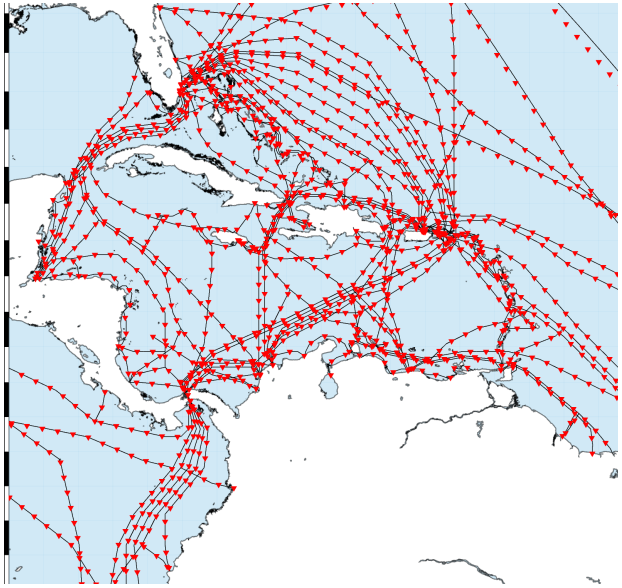
Berkeley Seismology Lab

Why now - Caribbean Sea?

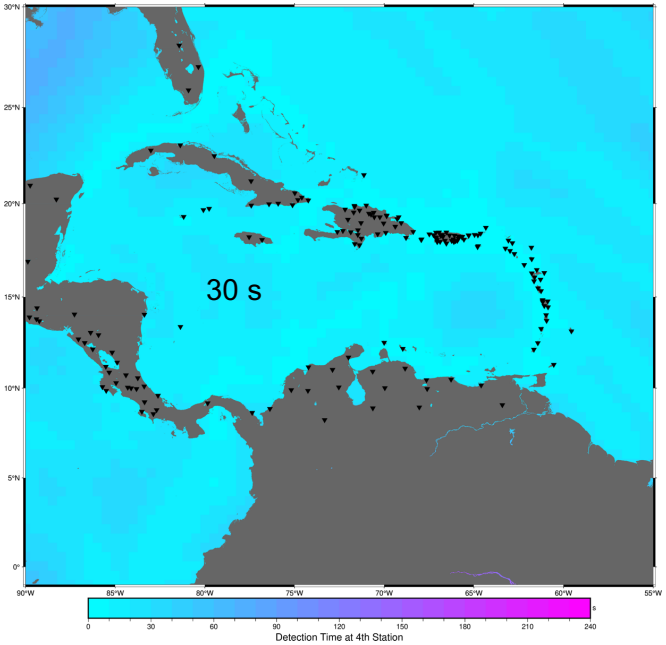
Detection times
Existing, NO SMART



Optimistic
all existing cables SMART



Detection times
EXISTING + SMART



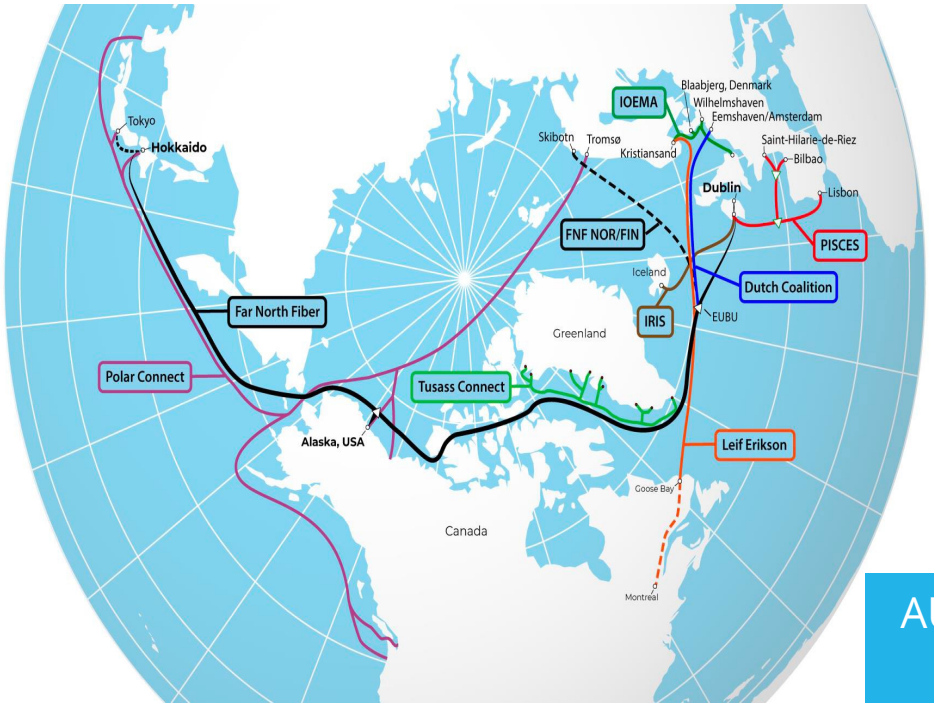
Detection Times for Earthquakes (at 4th station)

elizabeth.vanacore@upr.edu

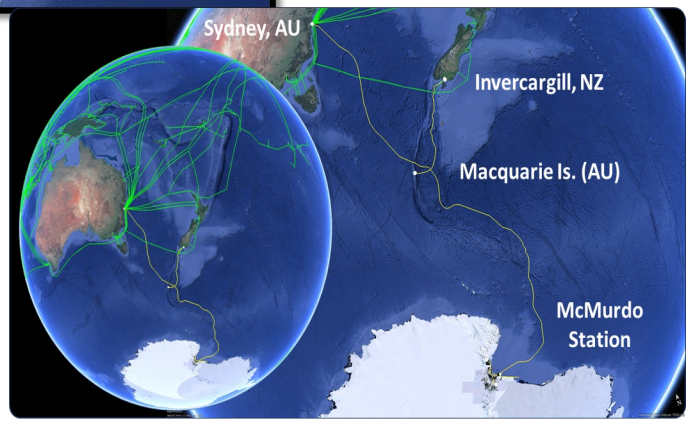
Dr Elizabeth A Vanacore,
Chair Task Team CARIBE WAVE 2

Global development: Polar and North Atlantic

Polar Connect, Far North Fiber, Tussas, PISCES, IRIS, IOMEA



Antarctica Chile
Drake Passage



AUS/NZ Antarctica
NSF McMurdo

SMART – Call to action

Global Array: Climate, Oceans, Sea Level, Earthquakes, Tsunamis

- Improve earthquake and tsunami early warning
- Reducing time to activate national protocols with better event location parameters and in situ sea surface elevation, and to evaluate the cancellation/updates
- Improve the Global Ocean Observing System with new long-term data
- Improve the understanding of ocean currents and heat content and sea level rise for climate change.
- Promote SMART Cables within your nations.

unesco
Intergovernmental Oceanographic Commission

Thank You

Scan to Join!

SMARTCables.org

ITU/WMO/UNESCO IOC Joint Task Force

Ceci Rodríguez Cruz
JTF SMART Cables Initiative
International Programme Office
University Hawai'i at Mānoa

Pacific Community
Communauté du Pacifique