SMART Subsea Cables for Observing the Ocean and Earth: An Update

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O1.3-705
Global Array: Climate, Oceans, Sea Level, Earthquakes, Tsunamis

Create a Planetary sensor, power, Internet network

Share submarine cable infrastructure
Telecom + science

NO Interference
1.2+ Gm
~20,000 repeaters
20 year refresh

repeaters ~70 km

CAM: 3700 km, Gov’t, install 2024 ➔ SMART Continent/Lisbon-Azores-Madeira ring

Bottom pressure, temperature, seismic acceleration

1st order addition to Ocean-Earth observing system

Know the environment – protect the network

UN Decade
Societal Benefits

Climate change – humanity’s greatest existential threat

Societal and environmental issues

UN Decade of Ocean Science

Climate SDG 13

– Climate change – ocean temperature, circulation, direct impact on societies, short and long term

Ocean SDG 14

– Sea level rise – hazard for coasts, islands, cities

– Disaster Risk Reduction – tsunami and earthquake monitoring throughout ocean basins and coastal margins

UN DRR

Infrastructure SDG 9, 11

– Societal Connectivity – Enable progress with resilient and sustainable telecom infrastructure
Ocean Observing Tools

SMART Cables measure Essential Ocean Variables: Pressure, temperature; seismic acceleration + …

Now:
Very few bottom obs

Future:
Add SMART Cables
Augment and complement present

Monitor ocean changes impacting resource use and circulation that drives weather and climate patterns

Adapted from Nerem, 2016
Science and Early Warning - Observables

Climate and Oceans

Temperature
- SMART ➜ Subsurface temperature, EOV
- Deep ocean warming ➜ sea level rise.
- Δ deep ocean temperature ➜ Δ circulation, Δ climate.

Circulation, sea level rise, mass distribution
- SMART Ocean bottom pressure (OBP, eEOV) ➜ expansion, melting ice ➜ sea level change (x,t).
- Δx between OBP ➜ depth-averaged currents and ocean circulation.

Hazards

Tsunami, Earthquake Warning
- SMART cables - vastly increase existing ocean pressure/seismic sensors
- Improve tsunami warning precision, Reduce unnecessary warnings/evacuations.

Seismology
- SMART Seismic accelerometers ➜ advance seismology:
  - Detect, locate small quakes below ocean floor
  - Rupture type and dynamics, larger offshore earthquakes
  - Image Earth’s interior
SMART Repeaters

Several approaches

Based on existing technology

Or, a separate SMART repeater with Telecom fiber pass-through

Temperature sensors

Alcatel ASN will supply – Details TBD
SMART Cables

Innovative + Transformative + Audacious too!

• “Joint Venture” – Science and $5B/y cable industry, 150y
• Suppliers will provide SMART (e.g., ASN)
• Cable integrity – societal connectivity
• Working within the UN system: ITU, WMO, IOC
• Research and Education Networks, e.g., GÉANT, RedCLARA, NORDUNet

• Systems at various stages:
  • Wet Demo/Sicily, Portugal, Indonesia, WesternMed, New Caledonia-Vanuatu, French Polynesia, New Zealand, Australia, India-Oman, Antarctica
  • Need to be engaged from the start of a project
• Start modest and simple – KISS in all aspects
  • Technical, domestic/bilateral, regional
  • Set precedents for funding, permitting, legal, security
• Work with all stakeholders
SMART Cables – CAM2

- Domestic system with international connections
- Explicit seismic, tsunami, ocean, environment
- 3700 km, €120M
- Cost effective - lives and infrastructure
- RFP 2021
- RFS 2024

LEA – Listening to the Earth under the Atlantic
Concluding Remarks

• SMART Cables – innovative path outside the "oceanography box"
• Transformative Technology enables science and early warning
• Unique observations of major importance with societal benefit
• Unlock the global deep ocean – extend power and comms infrastructure into the ocean
• CTBTO:
  – A dense global array coverage – ocean and climate, earthquakes and tsunamis
  – Planned and future sensors
  – Will improve IMS performance (hydroacoustic, seismic) with improved media
  – Technology similar – learn from each other
  – SMART cables will contribute to and complement the CTBTO mission

SMART Cables for Observing the Global Ocean: Science and Implementation  https://www.itu.int/en/ITU-T/climatechange/task-force-sc  bhowe@Hawaii.edu