OO Exchange, September 16, 2026
Topical focus: Seafloor Fiber Sensing and SMART Cables
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Summary

Twenty-eight attendees participated in the virtual session. The group was reminded to think about:

- What can we prioritize that's going to give us the most impactful and effective time series or data type for our scientific questions? How do we optimize those things?
- Which types of data and infrastructure can we include in our responses that are going to be most complementary across fields, interdisciplinary?
- Which components of the existing infrastructure would be most detrimental to remove?

After reviewing introductory information about the DCL process and available resources, and reviewing fiber sensing and the OOI's Regional Cabled Array (RCA), as well as SMART cables (current and future activities and applications), participants then split into four breakout groups. Attendees considered all questions contained in the request for input, however, much of the discussions focused on:

- Q1: How should NSF's investments complement and/or differ from other national and international efforts; for example, the National Oceanic and Atmospheric Administration's (NOAA) ocean observation systems?
- Q2: What gaps exist in observations to address high impact science questions and what oceanic regions could benefit from NSF ocean observations system(s)?
- Q3: What types of observations would best advance the national interest?
- Q4: What types of observations (e.g., pre-selected sites vs. moveable assets) are needed and what technologies are ready for implementation to ensure advancement of the state of the science?
- Q5: Which elements in NSF's existing observational portfolio should be maintained or updated to fulfil the identified needs?
- Q8: How should NSF seek to balance the development of new ocean observing technologies with the collection of more data using established technologies?

Key takeaways from this OO Exchange included:

- When considering NSF's investments in ocean observing vs. other national and international efforts…**NSF has traditionally prioritized fundamental and "frontier" science, funding efforts to better understand and evaluate novel technology. This is where NSF brings in value. Other agencies have more operational roles (e.g. NOAA, USGS)**. NSF fills the gap for funding research and development of emerging technologies that are not yet ready for operational implementation, or, funding interdisciplinary research that may identify unforeseen use cases of data that would not otherwise be included in operational workflows.
    - Training pipeline for scientists and engineers that are equipped with data analysis/instrument engineering skills to then enter the operational workforce relevant to national defense spanning natural hazards + marine event detection (Navy relevance)

    - NSF is the entity that makes the most sense to help with the **global development of SMART cables** - the collection of fundamental science data globally. Fiber sensing on global telecom cables is going to become the norm no matter what, and NSF has the opportunity to jump in on these activities in their earlier stages. **NSF should take the initiative and could act as a leader in this space.**
    - The SMART Cable sensing solution has been tested and is currently beginning installation. The solution is proven with academia and is a **low risk investment for NSF that utilizes emerging technologies and solutions and provides the necessary information today for scientific research.The system can be cabled, remote or installed in ROV's which adds flexibility**.
- For optimization of current and future ocean observing systems, there needs to be better collaboration (and coordination) across all levels: local, state, national, and international. Opportunities for multiuse of single sensors. If NOAA has a sensor for marine mammal monitoring, could that be used for other monitoring (e.g. seafloor sensing)? Also consider the use of platforms of opportunities (e.g. offshore power projects). Power and communication are always really important. Can other users arrange to pay for use of data/sensors maintained by a specific agency (could NSF could provide power connectivity to other instruments)? Could there be **discussions (about locations of interest, frequencies, etc.) between agencies before deployment so that multiple stakeholders can benefit/use the data generated? This would create more interested users for a particular technology and ensure that the technology was used by more people (better ROI).**
    - Forward thinking, if there is more cross-agency collaboration, or [external] platforms of opportunity are utilized, need to be **thoughtful about data governance**. How will data be managed? Where will the repository be? Will users have access to data in real time (for agencies and monitoring purposes, but also for the general public)? Data management systems should be developed with a clear data agreement and the ability to share the data openly.
- **We need both pre-selected sites and moveable assets.** Existing fiber optic cables, whether they are instrumented with DAS or with more traditional instruments such as SMART cables, can act as the backbone permanent observatories. These can then be supported by more individual PI-led temporary experiments that allow for higher-resolution understanding of localities of interest. **Permanent cable observatories also act as proving grounds for new technologies**. They provide a platform to test out new infrastructure, etc., and an opportunity to **compare new technological capabilities to established technologies** (for example, long-distance navigation technology…extending power, communication, navigation, etc from land domain to the ocean).
    - **The OOI-RCA has already served as a proving ground for fiber sensing. Long-term, permanent DAS on the OOI-RCA is a low hanging fruit that could provide both long-term and high resolution data, from the continental shelf to the abyssal plain, that supports earthquake and tsunami monitoring, microseismicity monitoring, ocean wave dynamics**

observations, marine mammal monitoring, geodetic monitoring, acoustic signal monitoring. However, DAS would be most useful if the OOI-RCA was instrumented with additional, more traditional pressure sensors, seismometers, geodetic instruments, etc.- these technologies work together.
    - Looking at the existing kind of capabilities in terms of SMART cables, there's certainly the opportunity to put other or more advanced sensors in those cables.
- Gaps/opportunities: **Fiber sensing can provide a window into the deep ocean and hard-to-reach areas of the oceans in general, which can support U.S. national securit**y - understanding of bathymetry, subsurface structure, acoustic background, water column properties, etc. **Subduction zones**, in terms of national security, create large ground shaking in the nearby coastlines, but they also generate tsunamis that can travel across ocean basins (national security).
    - A lot of various new concepts are being developed…new wave of sensors that may be completely mobile (e.g. geosense program by MBARI). Working on the marinization of DAS systems so they could be placed anywhere, not just where the cables are.
    - Seafloor fiber sensing is not just looking for earthquakes, it's also marine mammal monitoring (e.g. really robust whale populations in the Pacific Northwest). It observes ocean waves. The data can be used to image the subsurface, we can get high-resolution temperature… DAS and fiber sensing can support interdisciplinary, investigation and inquiry.
    - A **critical observational gap exists in the South Atlantic and Gulf of Guinea**. Currently, we have zero continuous deep-ocean observations of bottom pressure, seafloor seismic acceleration, and deep temperature below 2000m. This creates a dual gap: a high-impact scientific gap, as we cannot resolve Atlantic Meridional Overturning Circulation (AMOC) variability and deep ocean heat uptake, and a critical societal gap, as the entire West African coast - Cameroon, Nigeria, Ghana, Gabon - remains a tsunami blind spot with no early warning capability. Without continuous seafloor monitoring, we cannot model dynamic burial depth variation or predict impending failures. NSF ocean observing systems integrated with SMART Cables on planned routes such as 2Africa, WACS, and SAT-3 would simultaneously address climate science and infrastructure resilience. We equally need designated JTF members and consultants based in this zone to provide regular on-the-spot information, local maintenance expertise, and ground-truth validation that remote observations cannot deliver
- **AI connections:** Fiber sensing on existing cables, and the construction of SMART cables, will provide huge long-term time series and **datasets that will be needed to support AI-driven inquiry and science.**
- **Metrics for long-term datasets/seafloor sensing is challenging.** Things like large earthquakes don't happen very often. If you want to capture those, you might need to have instruments on the seafloor for a long period (e.g. 50 years). Precursory signals are often not identified until after large events occur, but if we don't have the sensing in place, then we would never capture and learn about them at all. **Need to be flexible in how we value these things.**

- There is national (and international) interest in:
    - **Maritime domain awareness** (acoustic sensing and other sensing activities)
    - **Ocean surveillance** (including the monitoring of anthropogenic activities and underwater surveillance with sensors for national defense such as submarine detection)
    - **Critical infrastructure protection** (at the state level but also a national security issue; this includes telecommunication cables)
    - **Geohazard mitigation** (minimize destruction from global disasters; more observation and monitoring will support early warning and allow the capture of precursory signals if they exist, etc.)
    - **Changing (physical/environmental) conditions and operational readiness**
- Partnerships: SMART cables are already an example of a partnership with industry (global telecommunications). Low operations and maintenance. Leverage this- **SMART cables offer a way to scale up science.**
    - NOTE: data that could be used for geophysical monitoring on seafloor fibers can also be used to evaluate the health of the cables (another opportunity for optimization).