DAS offers marine geophysicists access to broadband, meter-scale data spanning multi-kilometer apertures from shore to shelf.

Nathaniel Lindsey¹, Jonathan Ajo-Franklin²,³, Craig Dawe⁴, Lise Retallaeu¹, Biondo Biondi¹, and Lucia Gualtieri¹

¹Stanford University, ²Lawrence Berkeley National Laboratory, ³Rice University, ⁴Monterey Bay Aquarium Research Institute

Fiber-optic cables are everywhere
Distributed Acoustic Sensing turns a fiber-optic cable into a massive 1C seismic array (of strain-rate sensors).

Some Common Recording Parameters:
- Laser pulse width ~ 10 – 40 ns
- Spatial sampling (L_G) ~ 10 m
- Maximum aperture ~ 30 km (standard fiber)
- Laser pulse rate (t⁻¹) ~ 10 - 100 kHz
- Digital sampling ~ 100 – 1000 Hz
- Data flowrate ~ 0.01 – 10 TB/day

MARS cable laid in 2006 (UC Berkeley/MBARI)

- 52 km long, 0.5 - 1 m deep
- Provides power/comm to seafloor node
- Continuous operation 2006 - 2019
- No unused fiber
- Routine node maintenance 3 - 4 days / year

DAS-MARS cable experiment 2018

- 3.5 days
- Occupied 1 SMF from shore with Silixa iDAS
- 9,984 DAS @ dt=0.002 s, dx=2 m, LG=10 m
- Total collected DAS data volume = 3.45 TB
Meterscale AND multi-kilometer

Seafloor DAS in Monterey Bay records M1-3 California earthquake wavefields (at 10 – 50 km offsets) which show seismic phase conversions and 0.25-s S-wave delays at mapped and unmapped subsea faults.

<table>
<thead>
<tr>
<th>Time [s]</th>
<th>Normalized Strain-rate</th>
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<tr>
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</table>

Event: Mw3.4; Z=2.87 km; ~40km offset
Processing: FK-filter removes microseism
Observations: Weak P; Strong S/SS; azimuthal sensitivity; Secondary "point" scattering ~400-800 m/s; SS Wavefront delay = 0.5 s
Hypotheses: (1) Head waves, (2) FZ-trapped waves, (3) Body wave reflections

Hillers and Campillo, 2014
Broadband response

**Microseisms** around 0.05 – 0.2 Hz dominate 50 m depth DAS records, correlate with onshore seismometers and Pacific wave height. At 8 – 20 mHz, DAS channels show strong tidally-modulated signal.
Summary

● Fiber-optic Distributed Acoustic Sensing (DAS) represents a new way to explore ocean/solid earth processes.

● Quality data from single mode fiber inside armoured MARS cable buried at 0.5 m.

● Seismic wavefield from M3.4 earthquake at 40 km located faults in secondary scattering zones.

● Primary microseism energy dominates shallow water fibers.


● Longer period hydrodynamic processes also recorded by DAS (T=50 - 1500 s).

● Short-term access to optical fibers during maintenance is likely feasible, inquire with telecom operators.

Learn more about fiber sensing:
https://www.iris.edu/hq/initiatives/das_rcn
https://ctemps.org

Watch a tutorial on DAS:
https://www.njlindsey.com/

Read the papers: