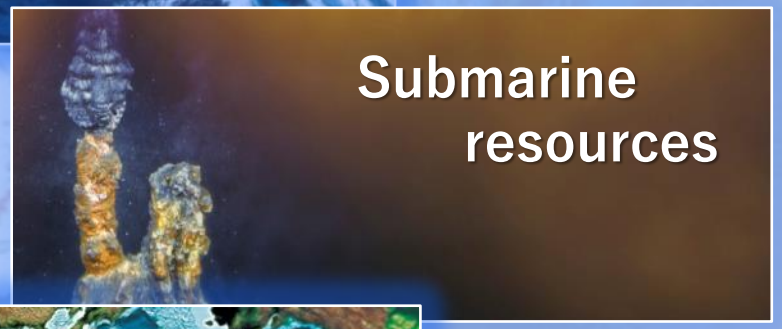
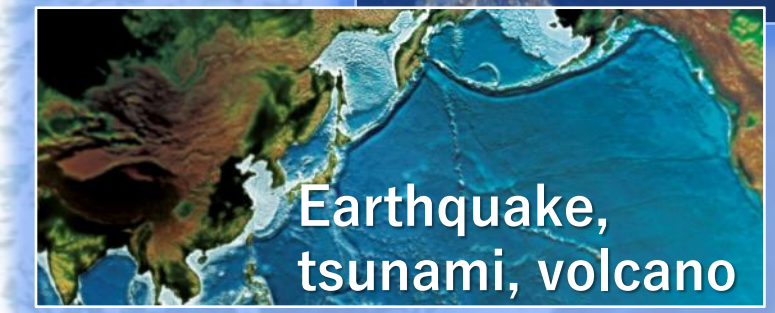
JAMSTEC

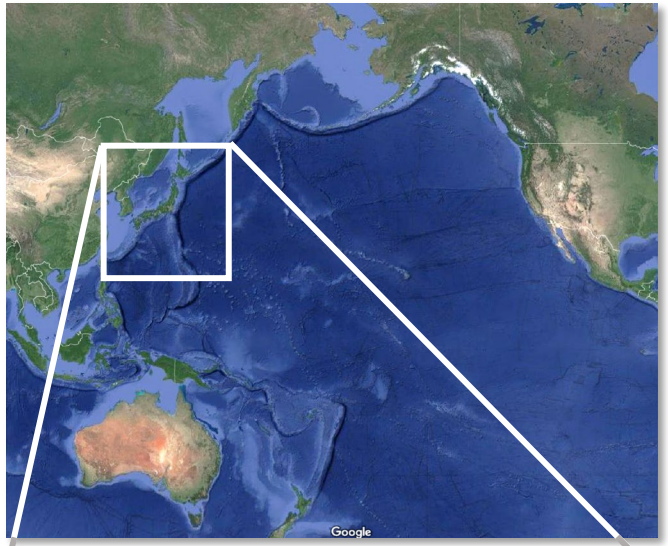
Japan Agency for Marine-Earth Science and Technology

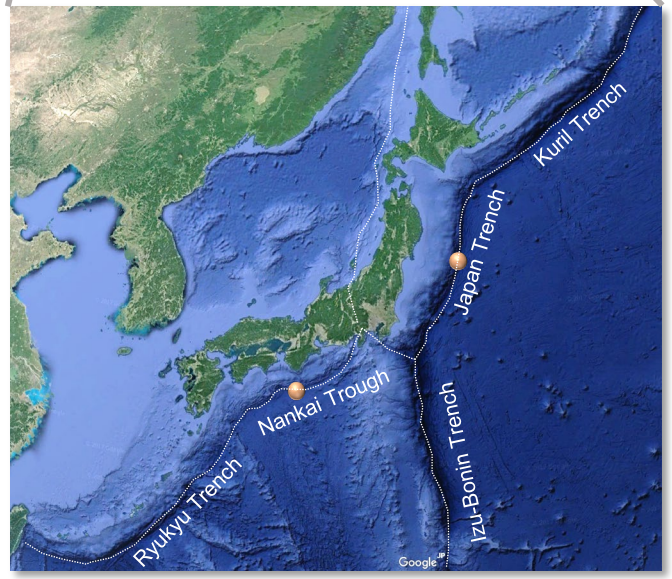
- Our vision: Integrated Understanding of the Ocean, Earth, and Life -

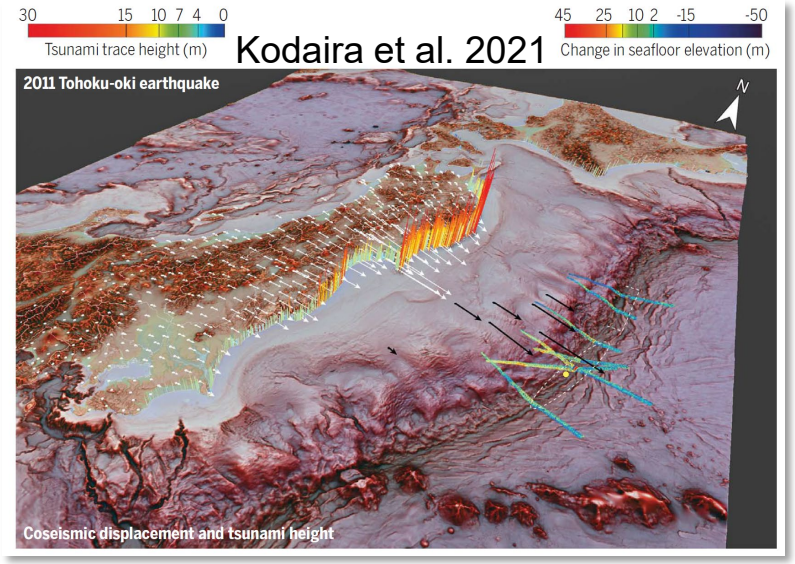




Earthquake and Tsunami in Japan

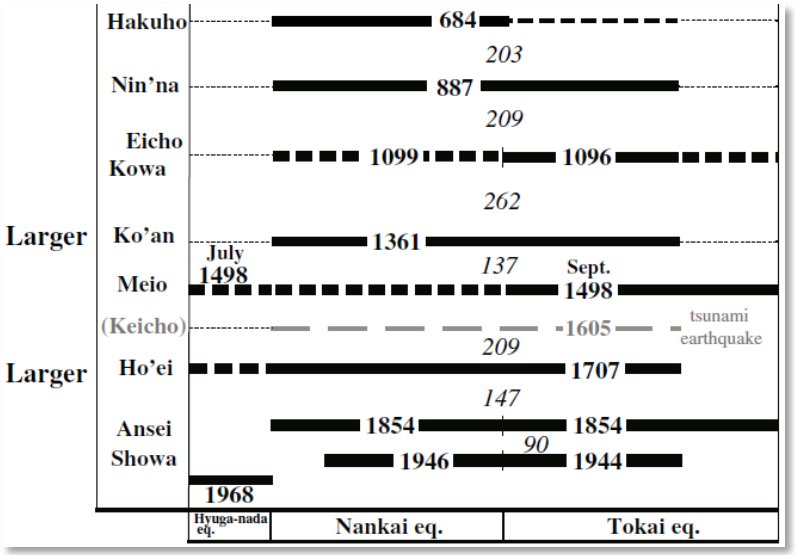






2011 M9 Tohoku-oki earthquake

more than 30 m high tsunami hit along the coast of the northeastern Japan



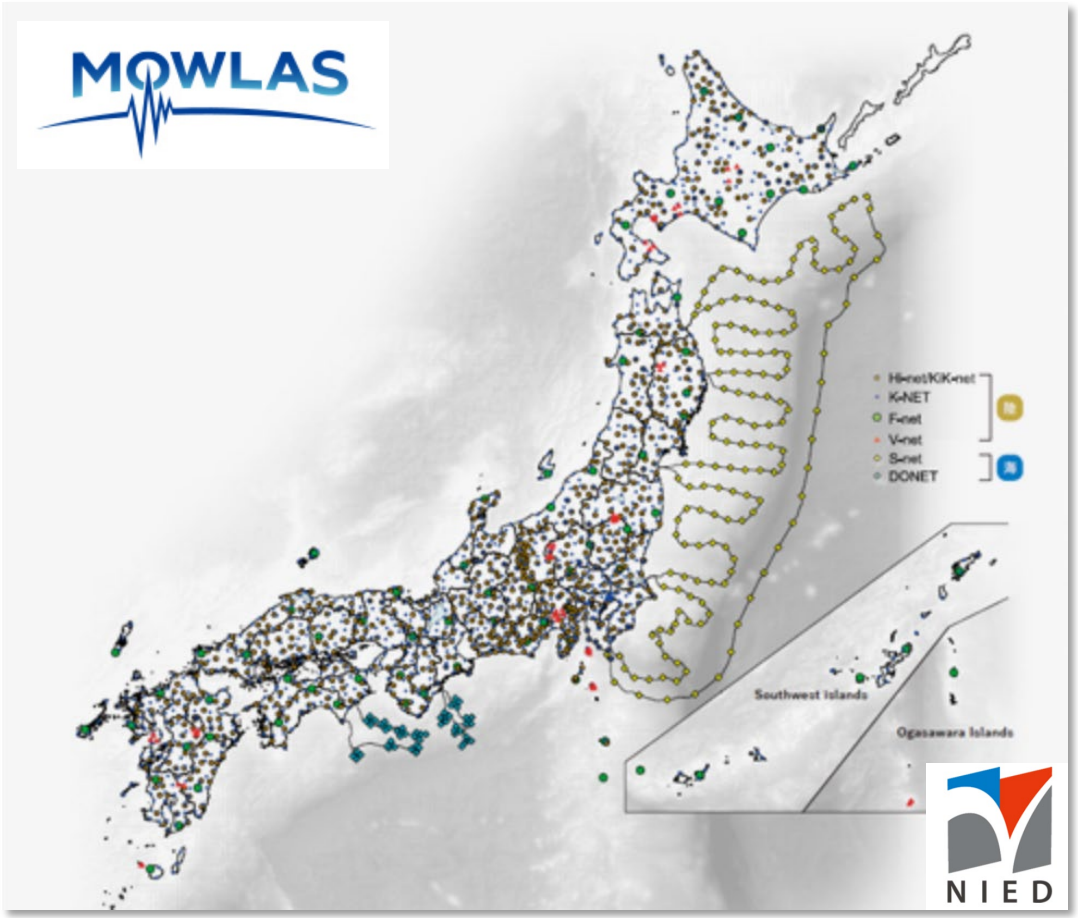
Hyodo et al. 2016

Nankai Trough seismogenic zone

M8 earthquake and tsunami repeatedly occurred every 90 – 260 years

1854 Ansei Earthquake (Osaka Museum of History)

Earthquake and Tsunami monitoring network



MOWLAS: monitoring waves on land and seafloor operated by NIED

“S-net” in the Japan Trench
150 stations of cable-embedded seismometer and pressure sensor

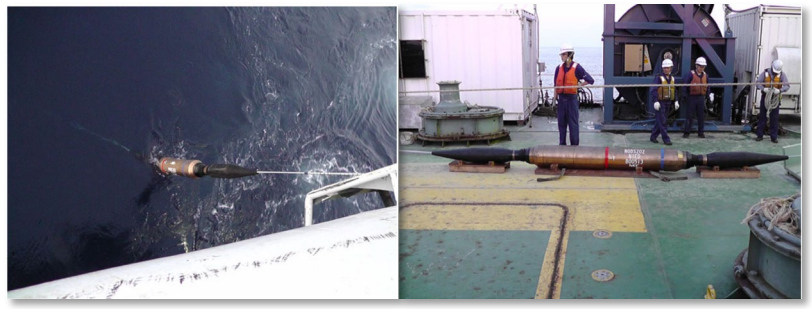
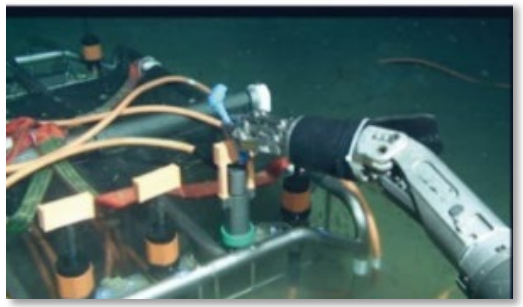
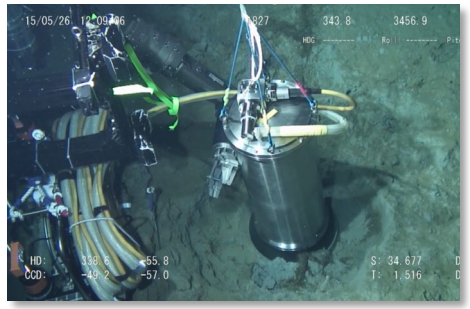


Photo: www.bosai.go.jp

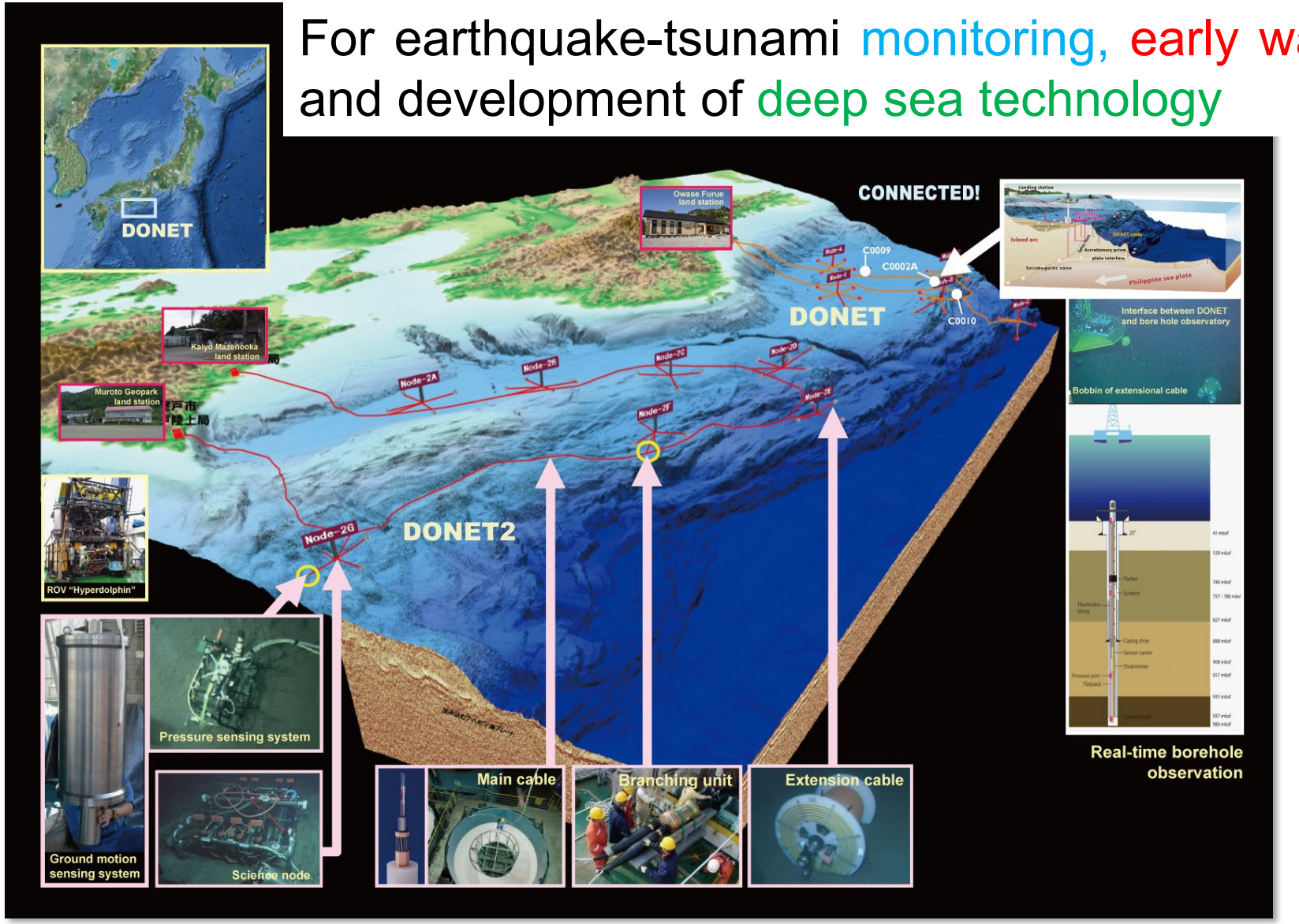
“DONET” in the Nankai Trough
51 stations of node-connected seismometer, pressure sensor and hydrophone, developed by JAMSTEC and operated by NIED





DONET: Dense Oceanfloor Network system for Earthquakes and Tsunamis

For earthquake-tsunami monitoring, early warning and development of deep sea technology



Reliability

designed for continuous seafloor observation over a long period of 20 years.

Redundancy

designed to be resistant to failures caused by external or unexpected internal sources.

Sustainability

designed to easily maintain and replace modular-typed sensor packages whenever an accident occurs or new and more advanced technology is developed.

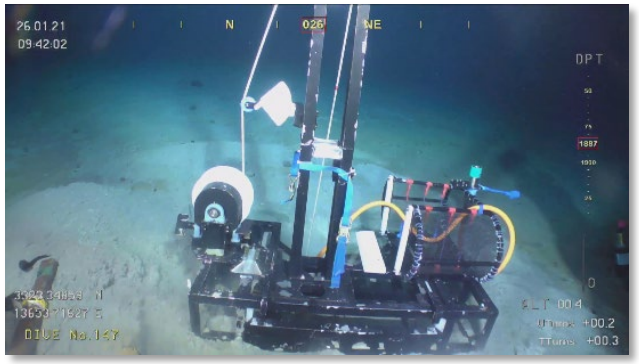
Toward understanding slip behavior and its temporal evolution
- what JAMSTEC are doing and plan to do -

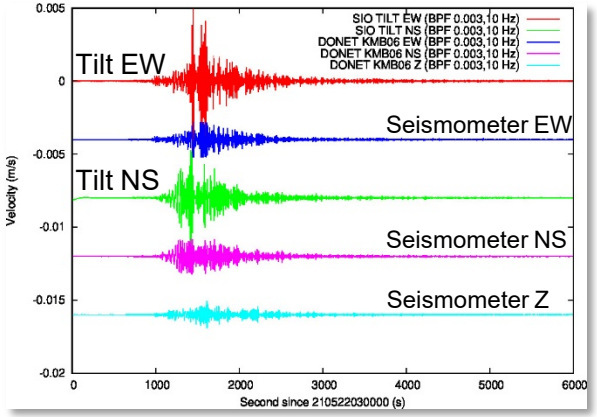
- construct seafloor geodetic network using DONET cable system
- install borehole observatory by BMS on R/V KAIMEI and/or D/V Chikyu
- calibrate all DONET pressure sensors to utilize them as geodetic sensors,
- develop fiber optic sensors to connect DONET

NIED

Fiber Optic Technologies applied to the Seafloor Network

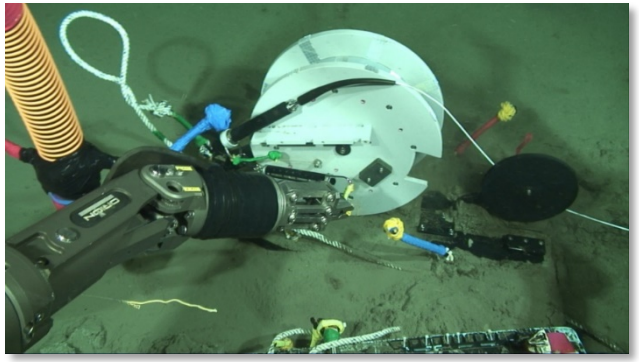
- Shallow borehole optical tiltmeter



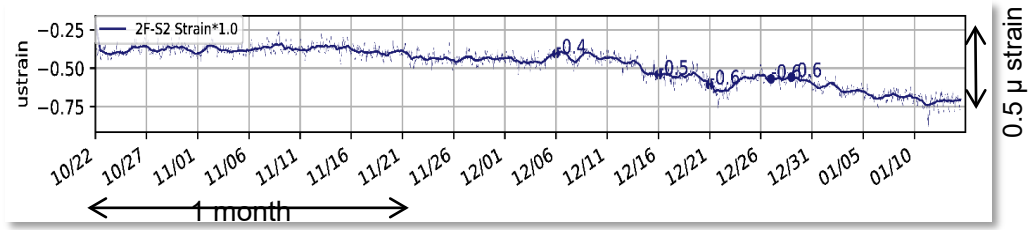


2021-05-21 UTC Qinghai, China, Mw 7.3 D=10.0 km

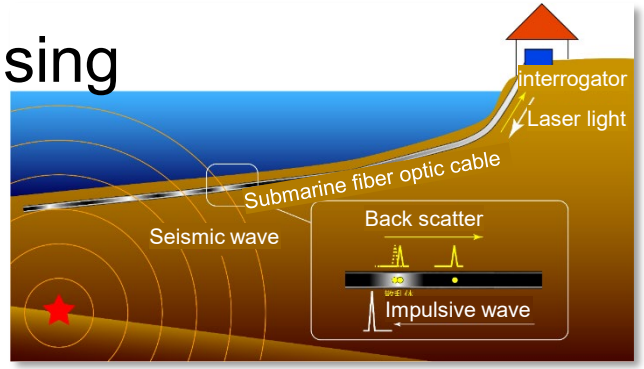
- Fiber optic strain sensor

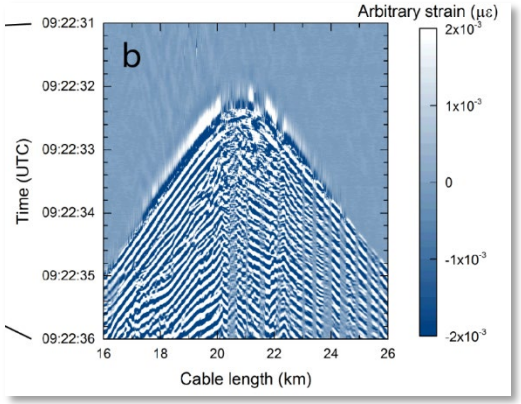


Long-term fiber optic strain deviation



- Distributed Acoustic Sensing (DAS)

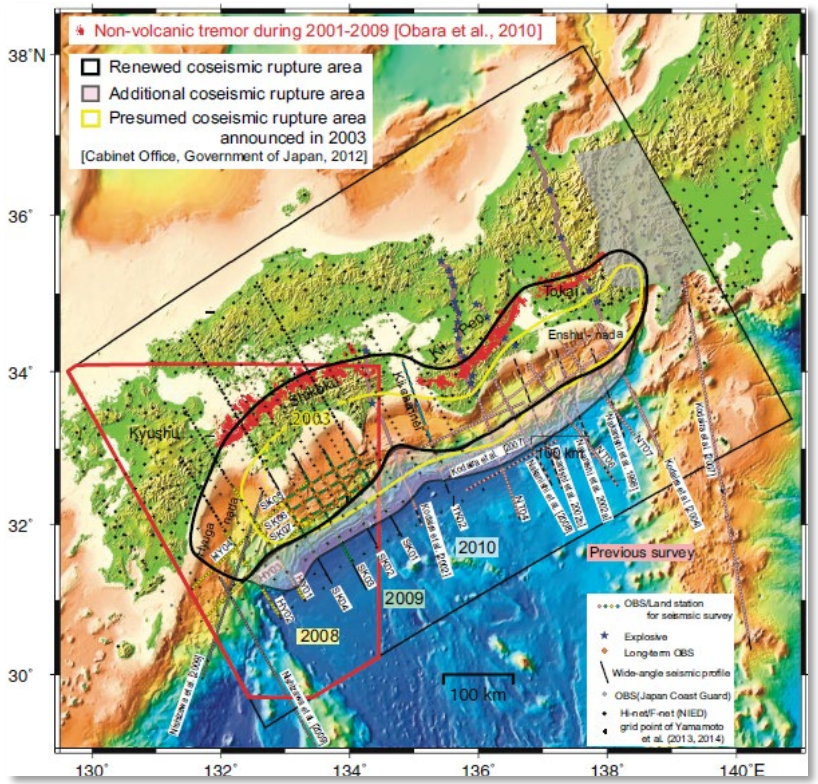




Hydro-acoustic signal form air-gun shots

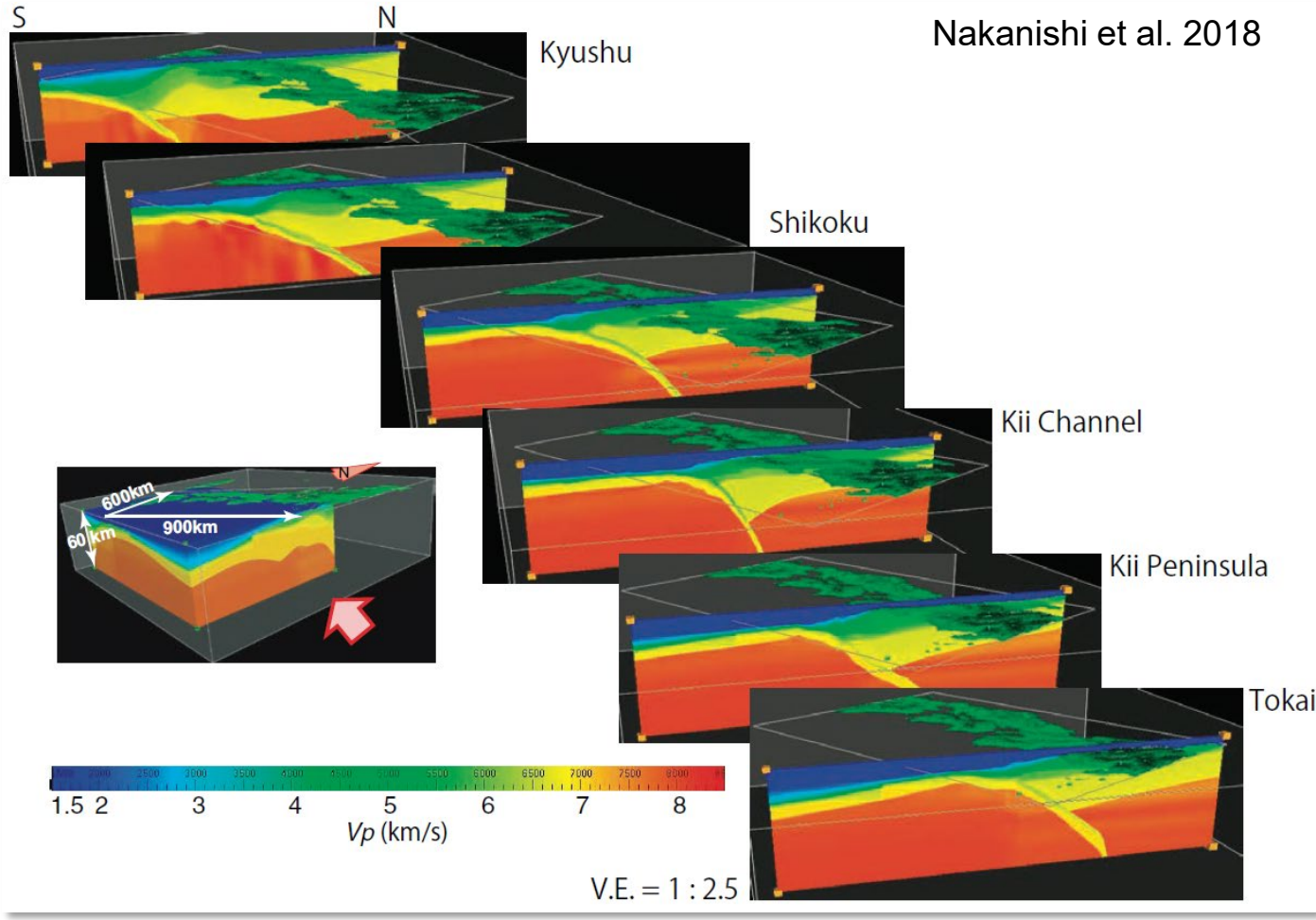
Micro to large earthquakes are also observed

Realistic 3D seismogenic zone model is necessary to transform seafloor/sub-seafloor deformation to plate boundary slips



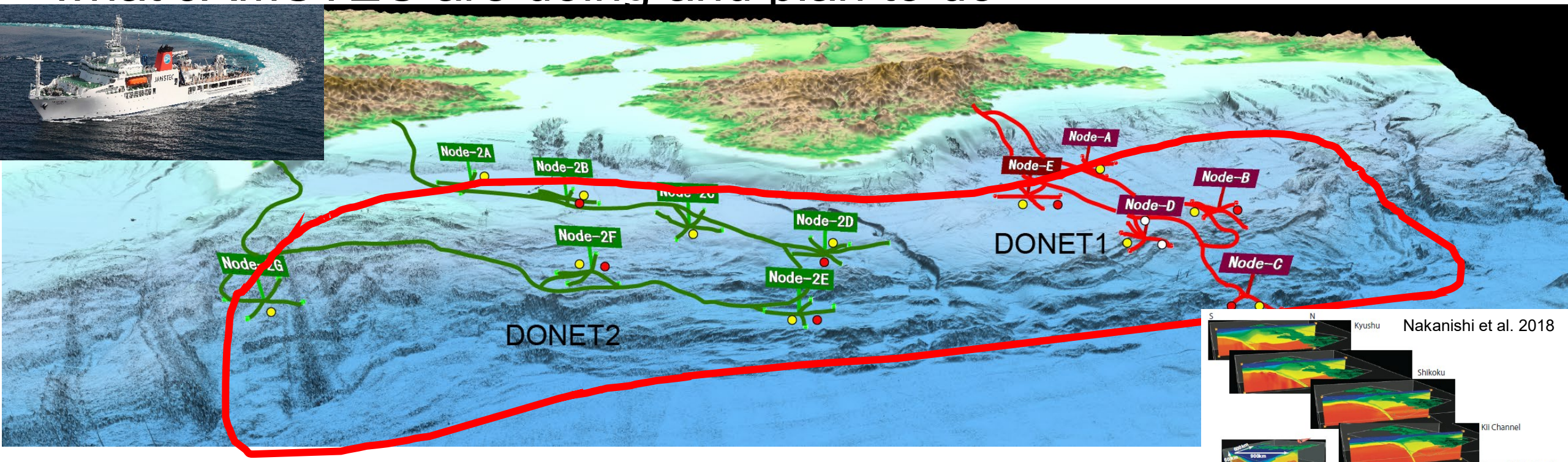
An overall velocity and plate geometry model by smoothly interpolating ~30 km spacing 2D profiles.

Plate boundary geometry of the offshore seismogenic zone have not been resolved.



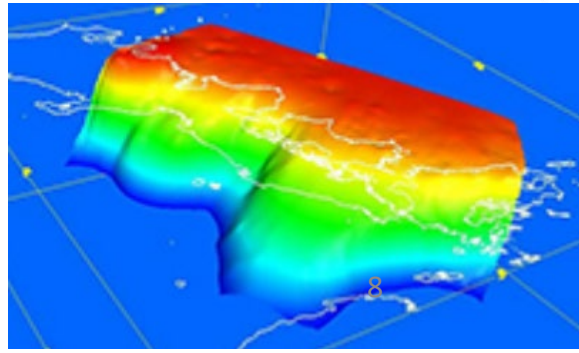
Nakanishi et al. 2018

Toward understanding plate coupling and its temporal evolution - what JAMSTEC are doing and plan to do -



Nakanishi et al. 2018

- Large-scale 3D imaging and high-resolution OBS imaging
- to construct a 3D multi-parameters model of the seismogenic zone



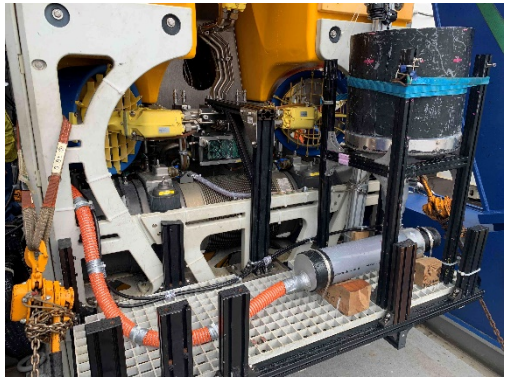
- the following sides are backup slide for discussion of question 2

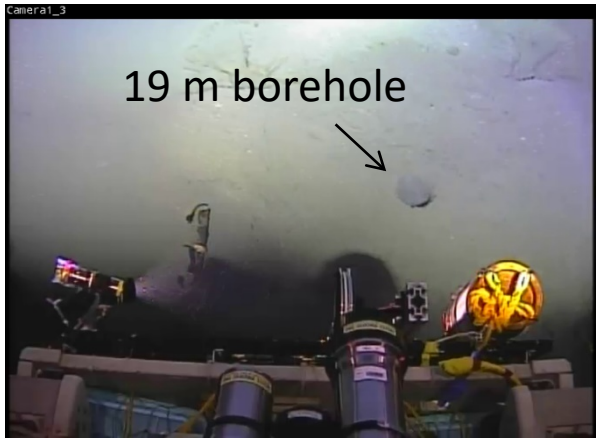
Underwater Technologies for Installation of Optical Tilt-meter

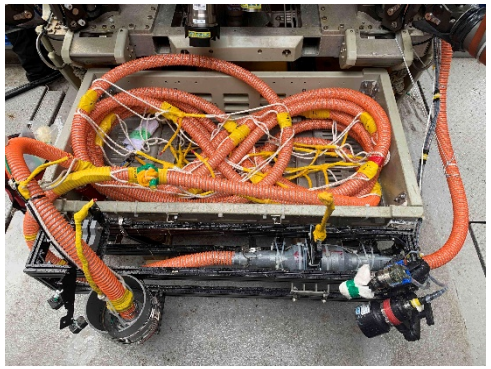
19m borehole

Boring machine system (BMS)

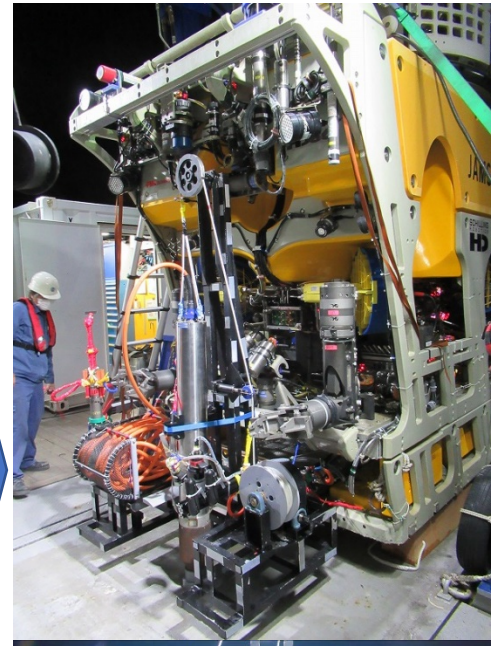
Better coupling to the borehole by ROV

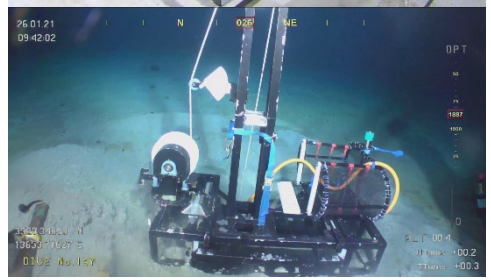




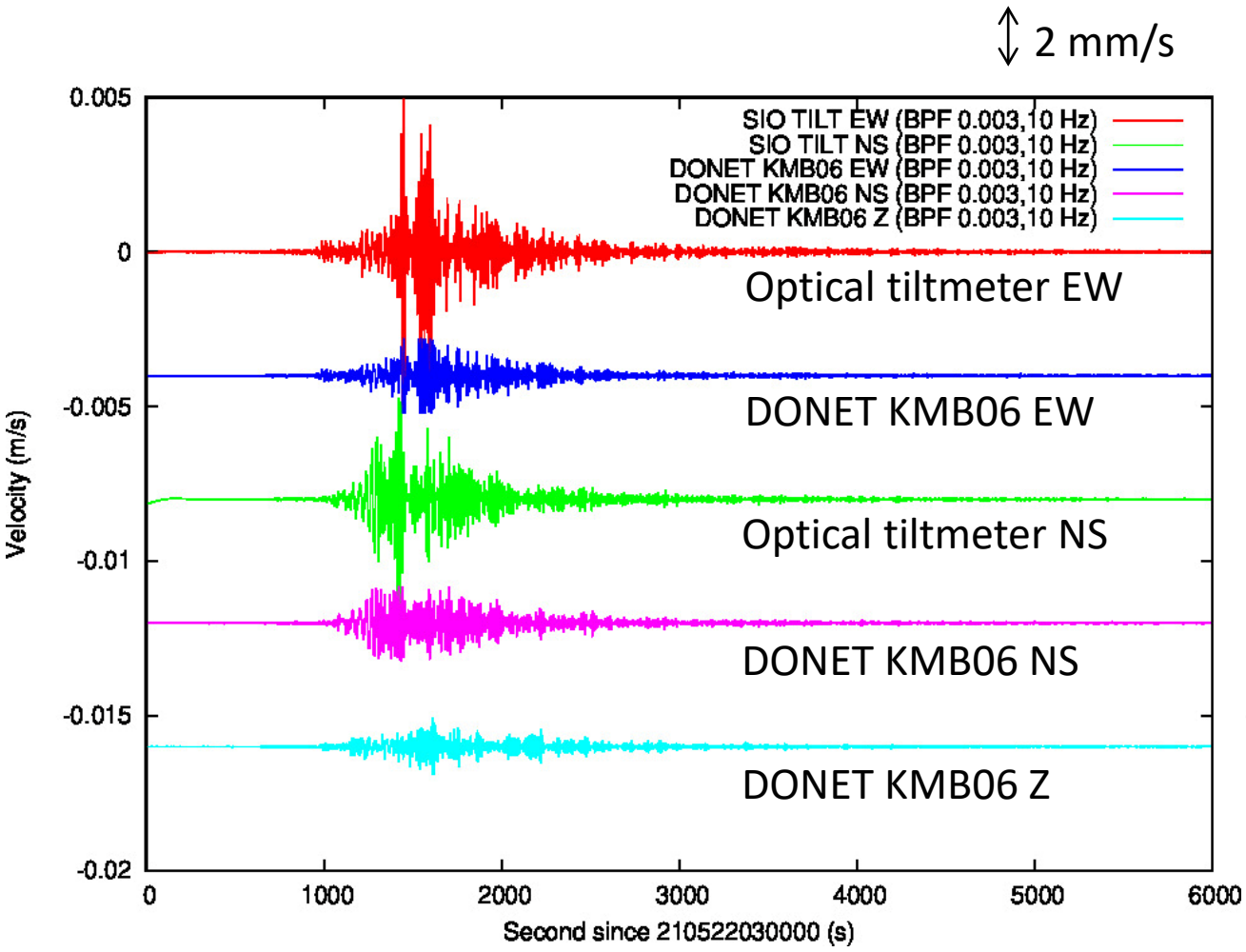


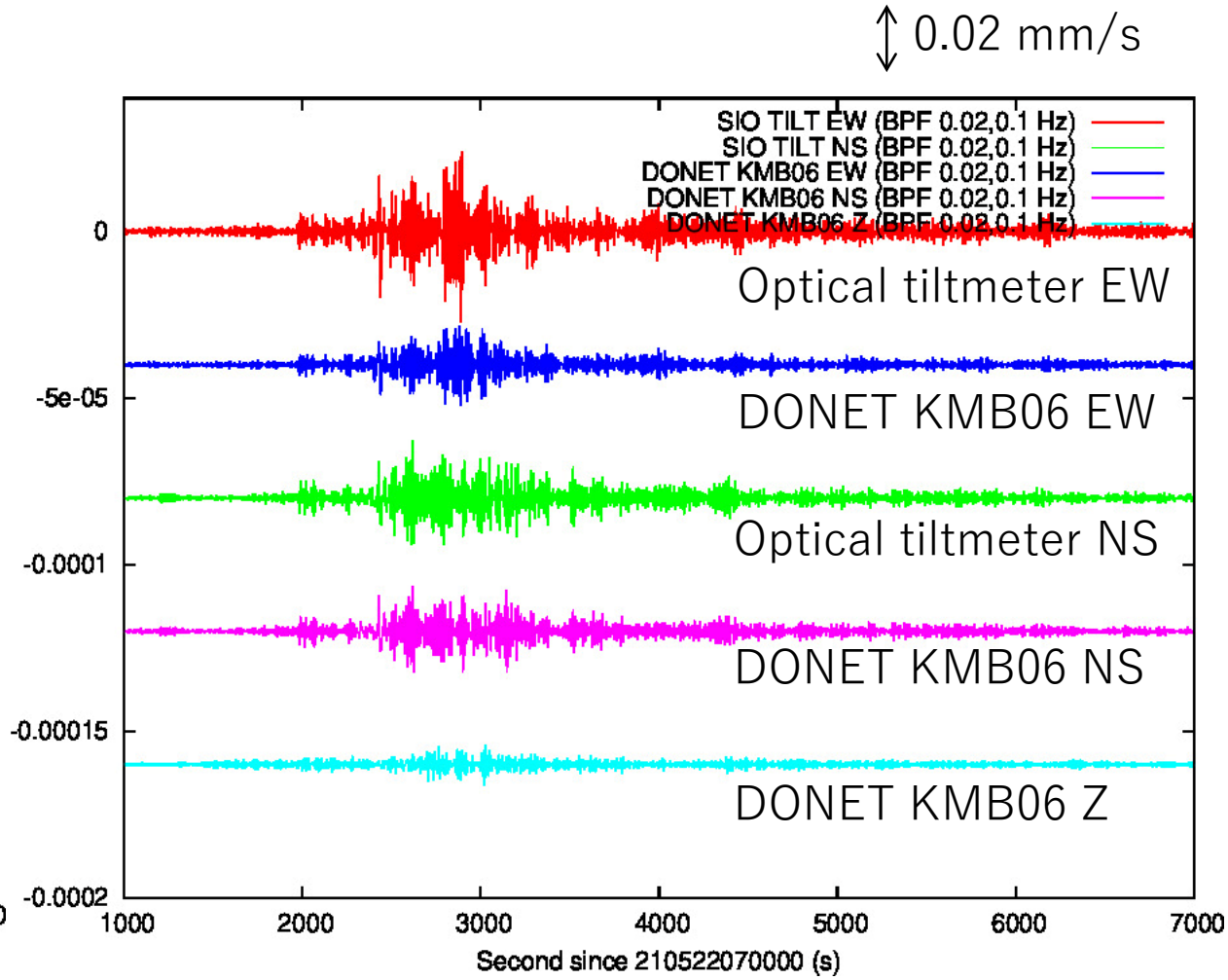
Sensor installation





Earthquake Observations by Optical Tiltmeter & Seismometer



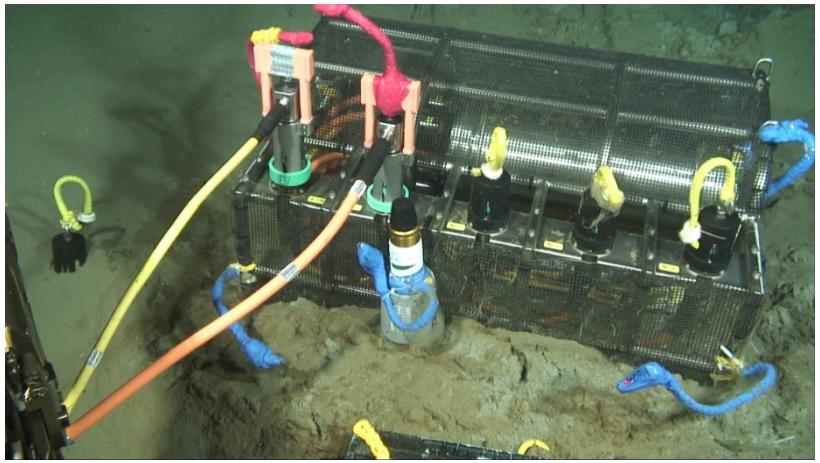


Date/Time 2021-05-21 18:04:13 UTC
Qinghai, China, Mw 7.3 Epi. distance: 3547 km
Lat. 34.6125° N Lon. 98.2458° E Depth 10.0 km

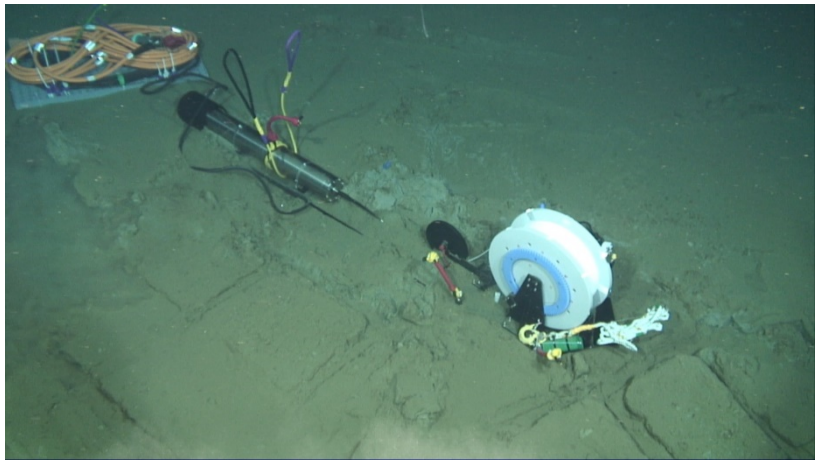
Date/Time 2021-05-21 22:13:18 UTC
Fiji Islands Region Mw 6.5 Epi. distance: 7385 km
Lat. 16.6009° S Lon. 177.3725° W Depth 10.0 km

Seafloor Strain Measurement by Fiber Optic Cable

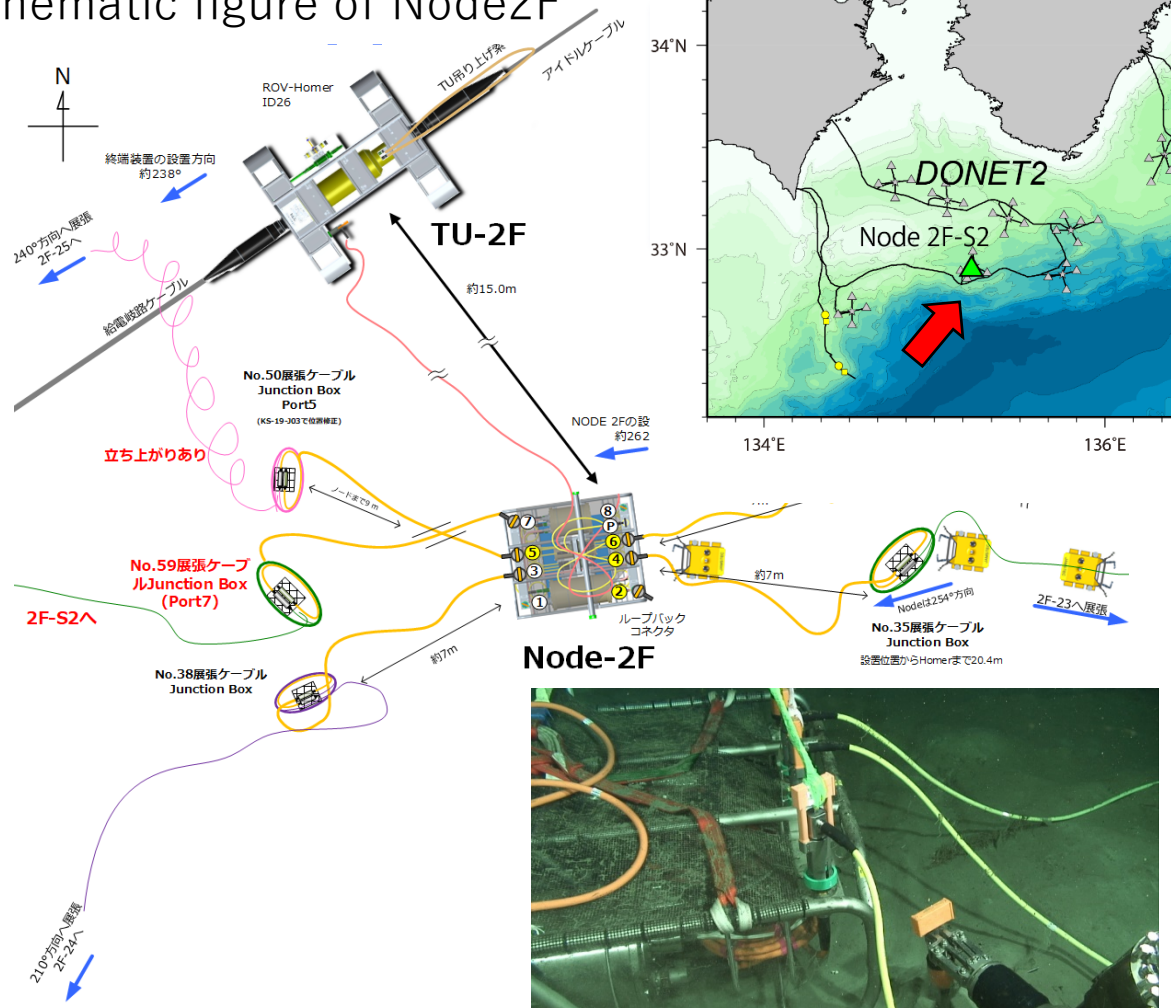
I/F unit

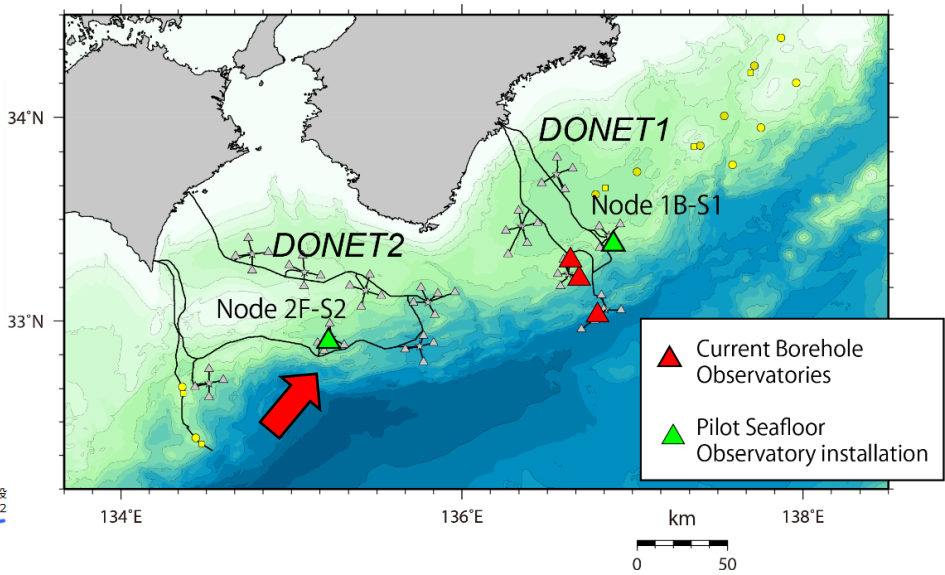


Cable-end at I/F unit side



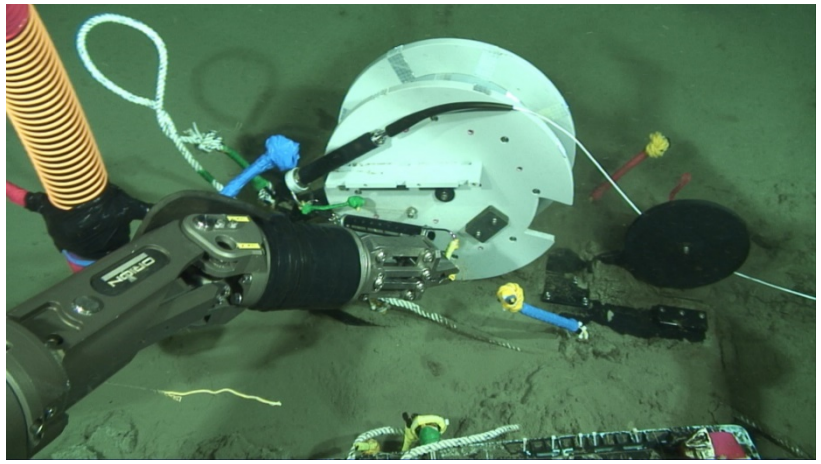
Schematic figure of Node2F

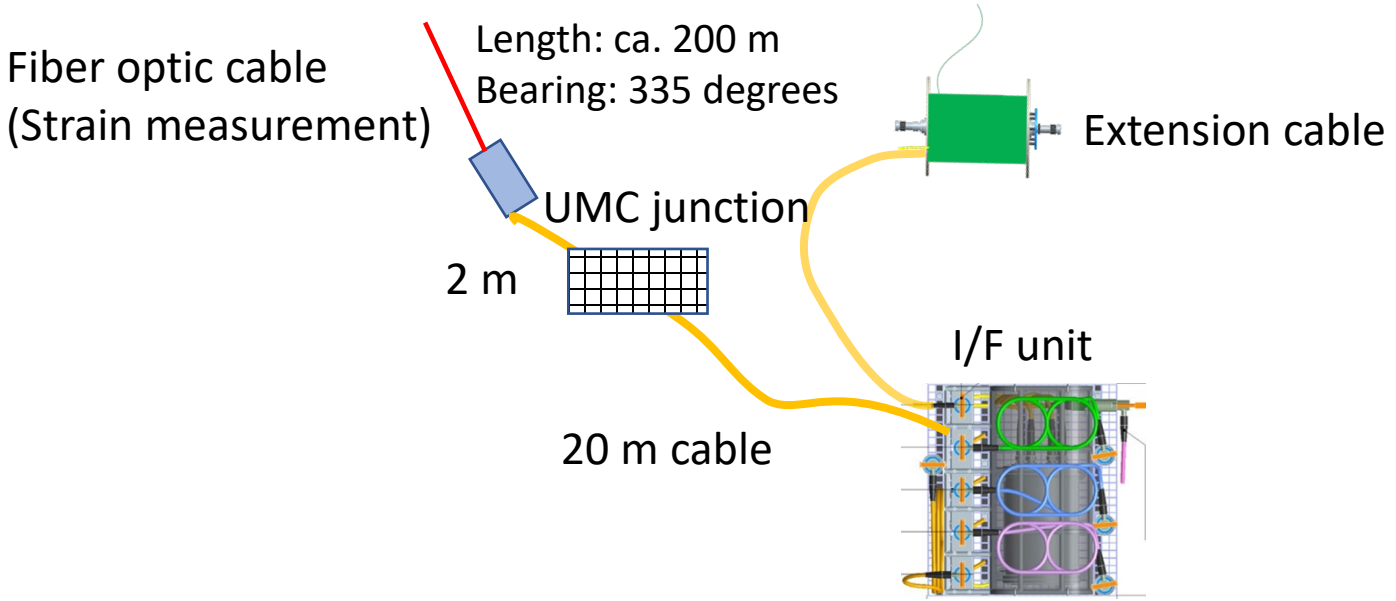




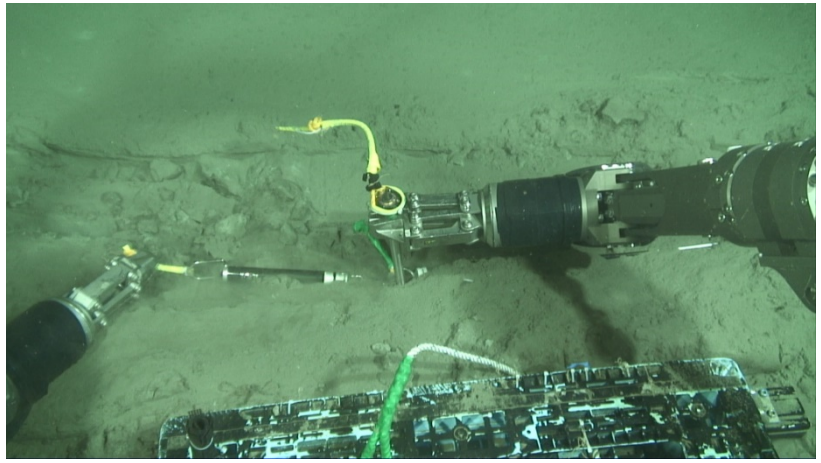
Seafloor Strain Measurement by Fiber Optic Cable

ROV operation for fiber optic cable laying

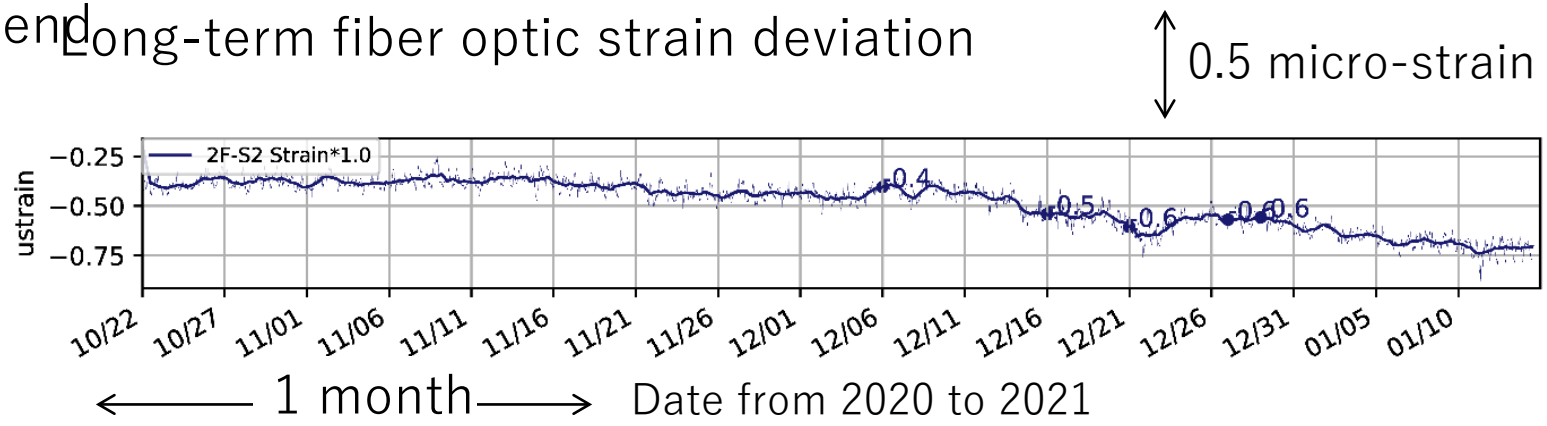




Tensioning of fiber optic cable at the end



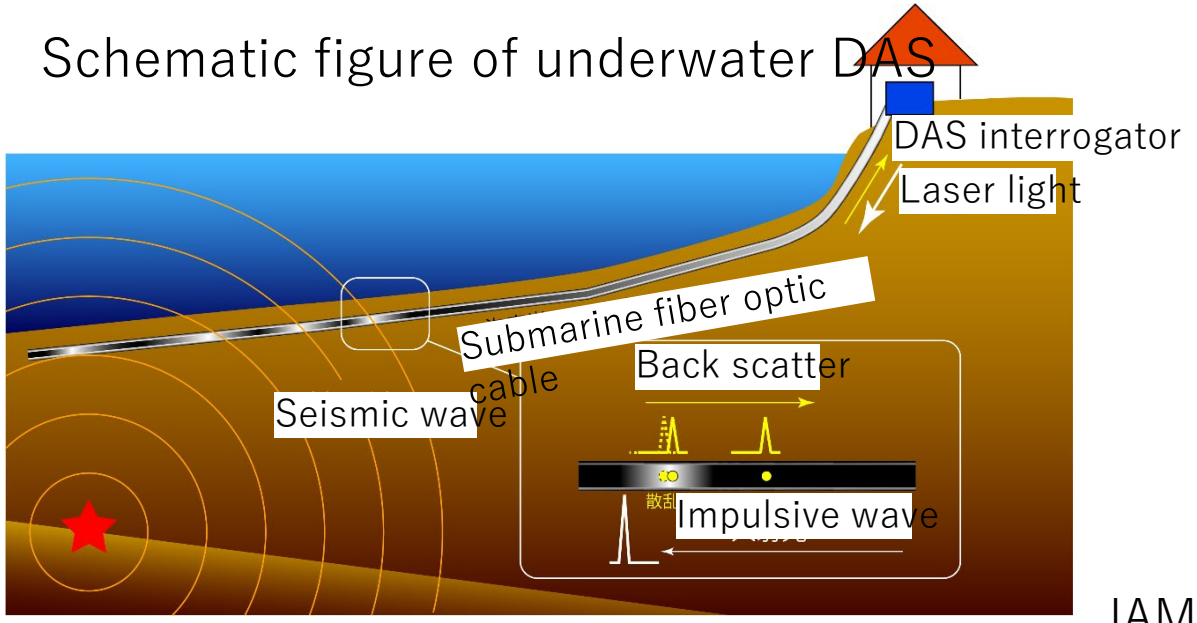
Long-term fiber optic strain deviation



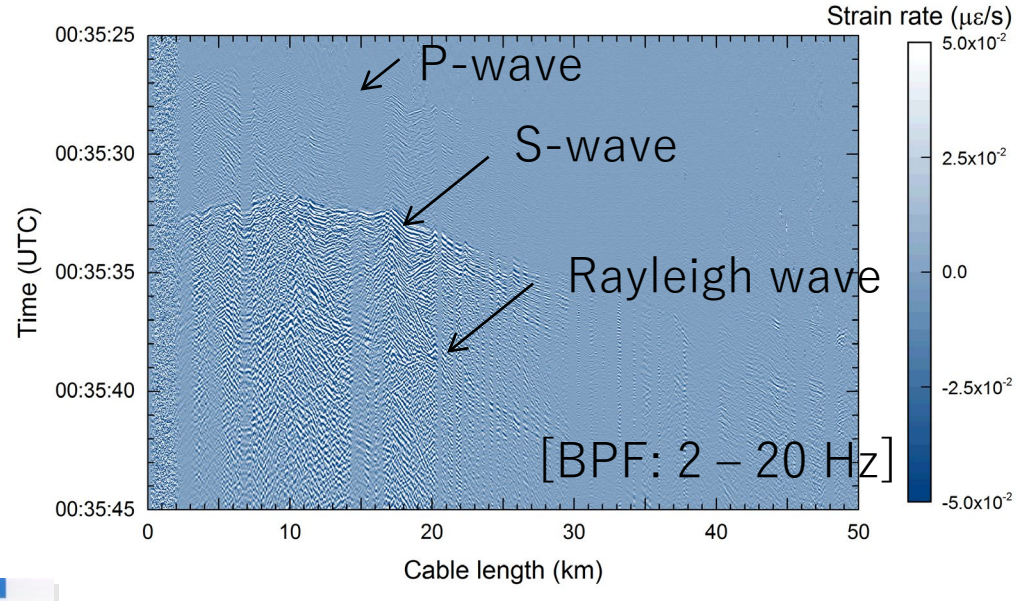
Araki *et al.* (2021, JpGU Meetir

Distributed Acoustic Sensing (DAS) for Seismic Signals

Schematic figure of underwater DAS

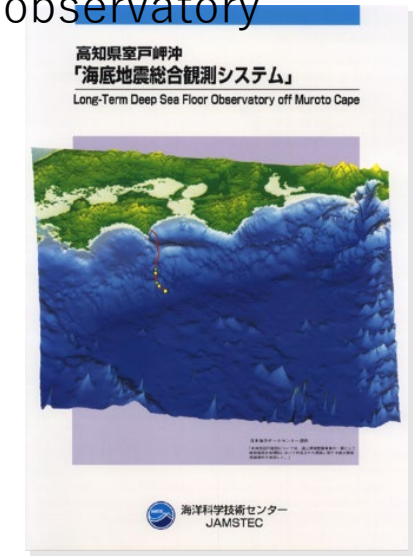


Detection of seismic signal
(Epi. distance: 40 – 100 km, Magnitude:1.7)



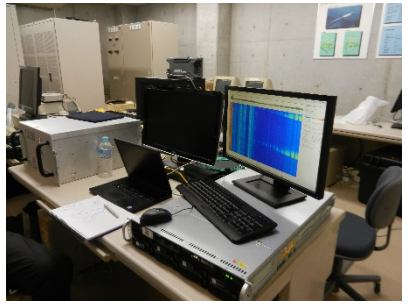
High resolution observation along a fiber optic cable
(e.g., 10-m interval & 500 Hz sampling)

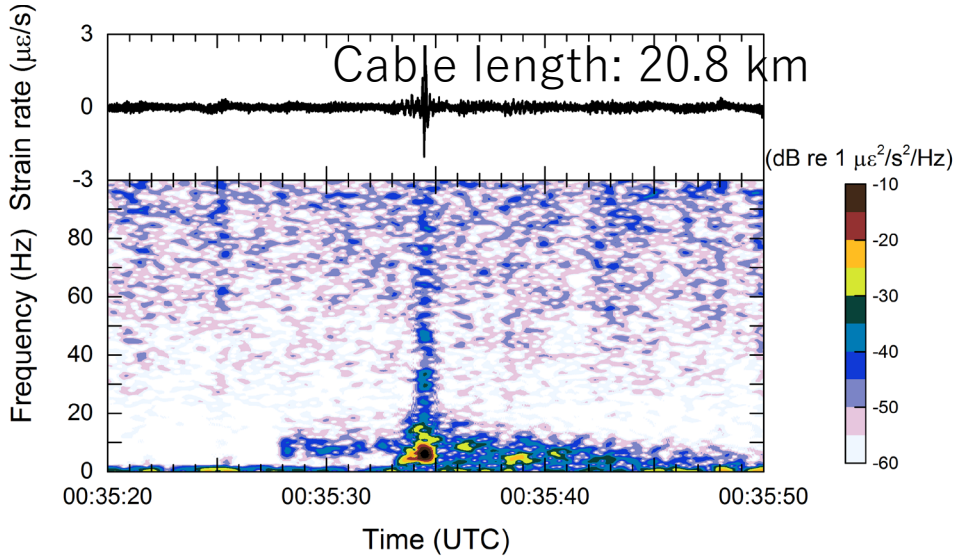
JAMSTEC off Muroto cabled observatory



Muroto landing station

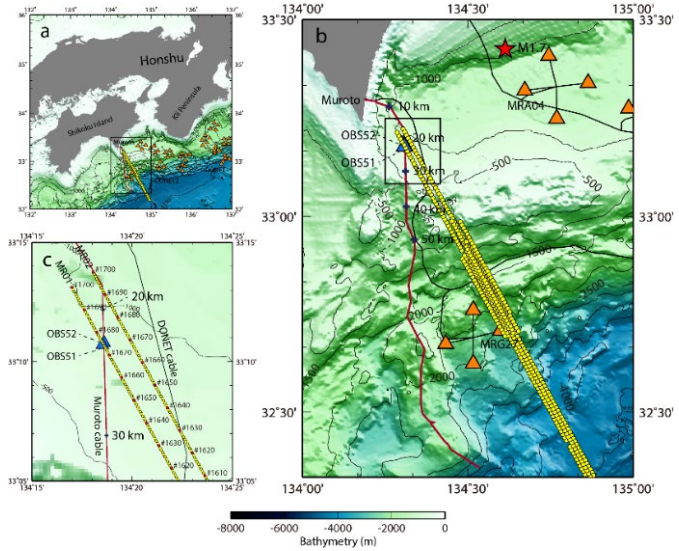
DAS interrogator



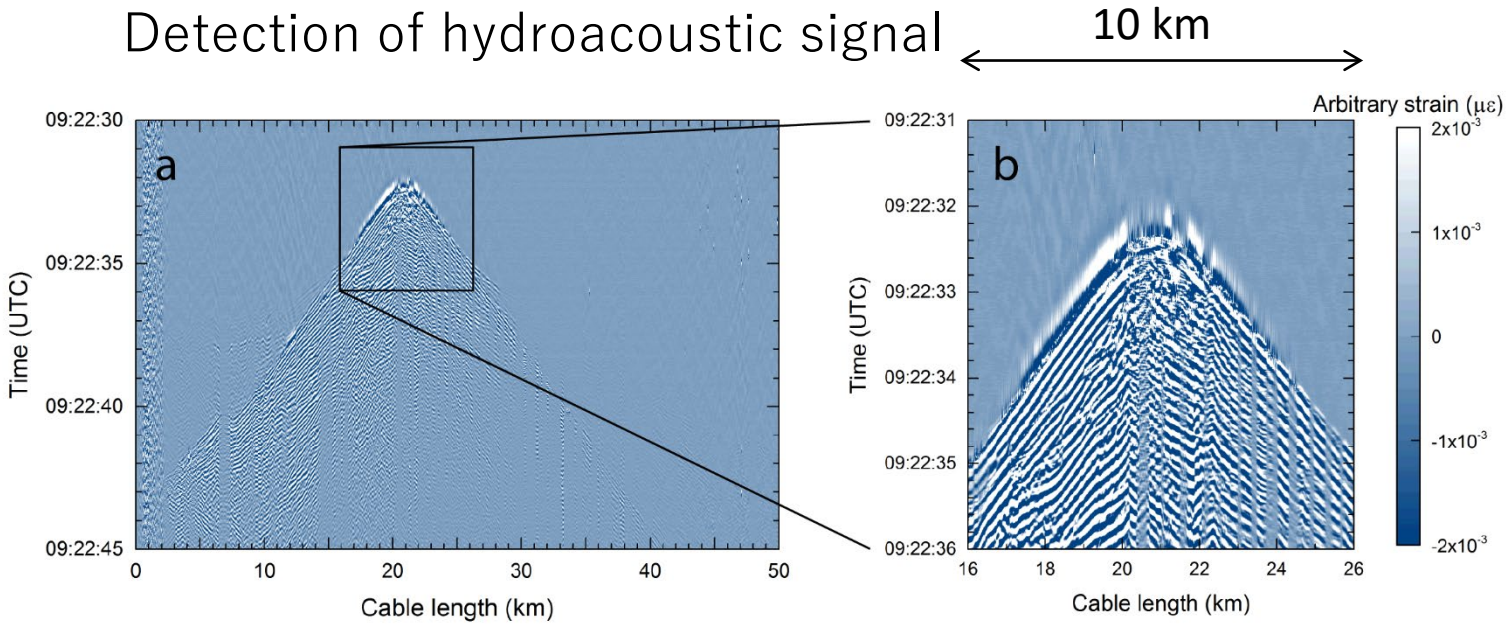


Distributed Acoustic Sensing (DAS) for Hydroacoustic Signals

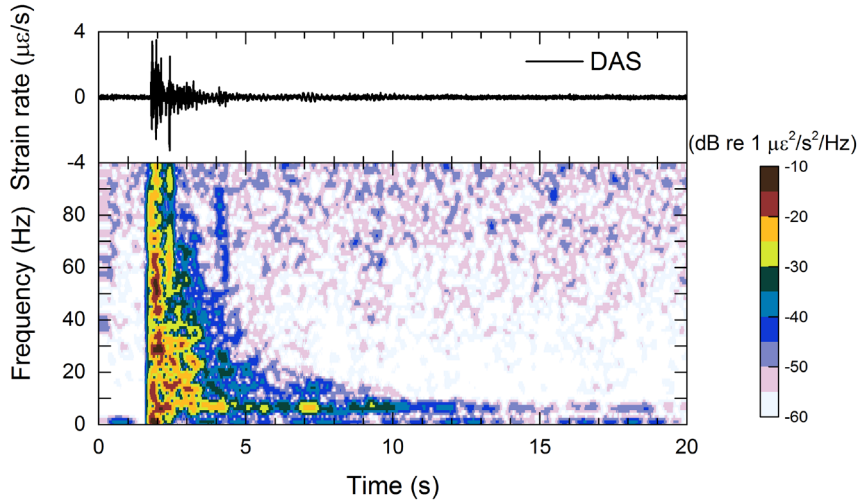
Air-gun sources location



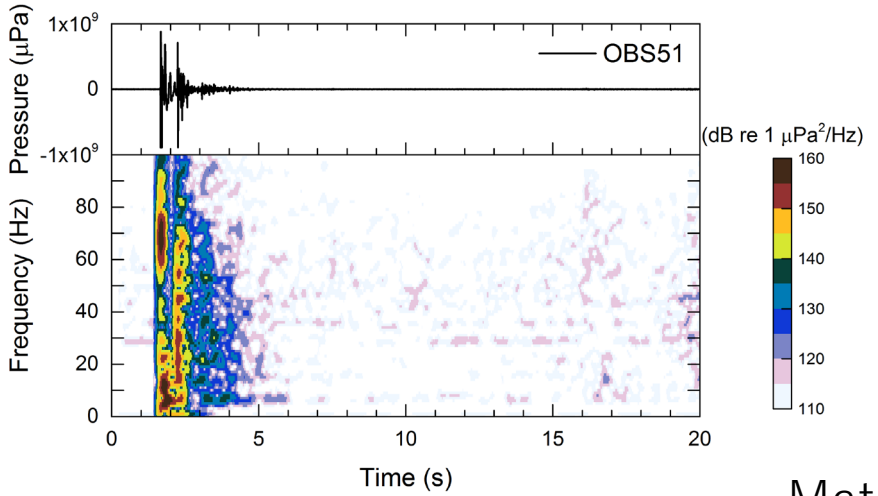
Detection of hydroacoustic signal



DAS observation



Hydrophone observation



Matsumoto *et al.* (2021