Crustal deformation observations and monitoring using a seafloor optical fiber strainmeter on the DONET seafloor cabled network

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Optical fiber instruments can provide high-fidelity measurements of solid earth signals across a broad dynamic ranging from seismic, microseismic, and infragravity activity to episodic tremor and slow slip to interseismic secular strain accumulation. Fiber optic instruments such as strainmeters, distributed temperature sensing, and distributed acoustic sensing, have gained considerable momentum in the last decade. A 200-m long optical fiber strainmeter was installed on the seafloor and connected to DONET Node 2F in June 2019. Since then, it continues to provide real-time in situ measurements for seismic and tectonic monitoring in the Nankai Trough, Japan.

We tested two configurations to assess the best installation and measurement practices for future deployments: (1) on 03 June 2019 the instrument fiber was nearly completely buried under several cm of sediment along the length of the fiber, and (2) on 08 October 2020, the fiber was lifted out of the sediment and laid across the bare seafloor with a small additional amount of tension.

Initial data and results were used to determine the thermal response and performance of the instrument and revealed signals possibly attributed to drift, initial loading and/or sediment settling effects. Nearby instruments including seafloor pressure gauges and broadband seismometers provide valuable data for comparison. We present results and insights addressing the following: (1) thermal response and behavior, (2) ocean tides and ocean tidal loading signals, (3) teleseismic events, such as the February 2020 M6.9 Kuril earthquake, and (4) performance comparisons based on the initial and adjusted instrument installation configurations and conditions.

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