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The Potential of DAS on Underwater Suspended Cables for Oceanic Current Monitoring and Failure Assessment of Fiber Optic Cables

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Distributed Acoustic Sensing (DAS) enables the use of existing underwater telecommunication cables as multi-sensor arrays. The great majority of underwater telecommunication cables are deployed from the water surface and the coupling between the cable and the seafloor is not fully controlled. This implies that there exists many poorly coupled cable segments less useful for seismological research. In particular, underwater cables include segments that are suspended in the water column across seafloor valleys or other bathymetry irregularities. However, it might be possible to use DAS along the suspended sections of underwater telecommunication cables for other purposes. A first one investigated here is the ability to monitor deep-ocean currents. It is common to observe that some particular sections of a cable oscillate with great amplitudes. These oscillations are commonly interpreted as due to vortex shedding induced by the currents. We investigate this hypothesis by estimating the oceanic current speeds from vortex frequencies measured in two underwater fiber optic cables located at Methoni, Greece, and another in Toulon, France. Our results in Greece are in agreement with in-situ historical measurements of seafloor currents while our estimations in Toulon are compatible with synchronous measurements of a nearby current meter. These different measurements therefore point to the possibility to exploit DAS measurements as a tool to monitor the activity of seafloor currents. A second possible application of DAS is to estimate how the cable is coupled to the seafloor, even in the absence of the strong oscillations associated to vortex shedding. For that, we have analyzed the spectral signature of the different cables. Some sections feature fundamental frequencies as expected from a theoretical model of in-plane vibration of hanging cables. By analyzing how the fundamental frequencies change along the cable, we are potentially inferring the contact points of the cable with the seafloor, which will promote fatigue of the cable and potential failure. This mapping of the coupling characteristics of the cable with the seafloor could also be useful to better interpret other DAS signals.