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The Potential of DAS on Underwater Fiber Optic Cables for Deep-Sea Current Monitoring

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Distributed Acoustic Sensing (DAS) enables the use of existing underwater telecommunication cables as multi-sensor arrays, allowing for detailed study of the seismic wavefield. Since underwater telecommunication cables were not deployed for seismological investigations, the coupling between the cable and the seafloor varies, dramatically reducing the usefulness of poorly coupled cable segments for seismological research. In particular, underwater cables include segments that are suspended in the water column across seafloor valleys or other bathymetry irregularities. Here, we propose that ocean bottom currents may be studied by monitoring the vibrations of suspended cable segments. We analyze DAS-strain recordings on three dark fibers deployed in the Mediterranean Sea. Several cable segments, presumably suspended, feature high-amplitude signals with harmonic spectra as expected from a theoretical model of in-plane vibration of hanging cables. The spatial shape of the vibration modes are determined by filtering and stacking. Their comparison to theory allows constraining the attenuation of longitudinal waves propagating along the cable in the non-suspended sections. The vibration frequencies change over time scales of tens of minutes. Assuming that oscillations of suspended sections are driven by deep sea currents, the temporal fluctuations of the vibration frequencies are related to changes of the cables tension which, in turn, are related to the drag force induced on the suspended cable by the shedding of Karman vortex. On this basis, we propose a method to infer changes of deep sea current speeds from the changes of fundamental frequency of cable vibrations. Submarine optical reconnaissance campaigns and controlled smaller-scale experiments are planned to validate the approach. The work aims at demonstrating the potential of using suspended telecommunication cables to monitor and investigate marine currents in deep ocean environments.