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Understanding surface-wave modal content for high-resolution imaging with ocean-bottom distributed acoustic sensing

Zack Spica[1], Loïc Viens[1], Mathieu Perton[2], Kiwamu Nishida[3], Takeshi Akuhara[3], Masanao Shinohara[3], and Tomoaki Yamada[3]

[1]Earth and Environmental Sciences, University of Michigan, Ann Arbor, United States of America (zspica@umich.edu)
[2]Instituto de Ingeniería, Universidad Nacional Autónoma de México, CDMX, Mexico
[3]Earthquake Research Institute, The University of Tokyo, Tokyo, Japan

Ocean Bottom Distributed Acoustic Sensing (OBDAS) is emerging as a new measurement method providing dense, high-fidelity, and broadband seismic observations from fiber-optic cables. Here, we use ~40 km of a telecommunication cable located offshore the Sanriku region, Japan, and apply ambient seismic field interferometry to obtain an extended 2-D high-resolution shear-wave velocity model. In some regions of the array, we observe and invert more than 20 higher modes and show that the accuracy of the retrieval of some modes strongly depends on the processing steps applied to the data. In addition, numerical simulations suggest that the number of modes that can be retrieved is proportional to the local velocity gradient under the cable. Regions with shallow low-velocity layers tend to contain more modes than those located in steep bathymetry areas, where sediments accumulate less. Finally, we can resolve sharp horizontal velocity contrasts under the cable suggesting the presence of faults and other sedimentary features. Our results provide new constraints on the shallow submarine structure in the area and further demonstrate the potential of OBDAS for offshore geophysical prospecting.