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Monitoring Spatiotemporal Seismic Velocity Changes Using Seismic Interferometry and Distributed Acoustic Sensing in Mexico City

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Mexico City, the most populated city in the Americas, undergoes significant seismic hazards. Conventional seismometers often suffer from limited spatial density, restricting detailed observations in urban areas. In contrast, Distributed Acoustic Sensing (DAS) can convert standard telecommunication fiber-optic cables into dense seismic arrays, providing great potential for high-resolution spatiotemporal monitoring. Therefore, we installed a DAS interrogator in Mexico City in May 2022 in a long-term fashion to collect data for observational studies in the region. The fiber crosses the city from south to north along a 29-kilometer path following the subway track. The dataset comprises 2266 channels with a 12.8-m spacing and a 200-Hz sampling rate.

On Sep. 19, 2022, a Mw7.6 earthquake occurred in Michoacán, approximately 450 km away from the City. Exactly 37 years after the great 1985 Mw8.1 event. The DAS system provided high-quality, ultra-dense, yet unique data for this earthquake in particular. One of the goals of this study is to assess the earthquake-induced changes in the sedimentary basin material properties. For this endeavor, we employ seismic interferometry on the ambient noise field of DAS data and the stretching method to monitor seismic velocity variations in Mexico City. Our analysis reveals a velocity drop following the 2022 Mw7.6 earthquake in some city areas. The results indicate that DAS can effectively monitor the velocity variations in urban environments, offering valuable insights for urban hazard assessment.