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High precision and high resolution monitoring of subsurface changes with DAS and airgun

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Recently large-volume airgun arrays have been used to explore and monitor the subsurface structure. The airgun array can generate highly repeatable seismic signals, which can be traced to more than 200 km. And the airgun source can be ignited every 10 minutes. The airgun source makes it possible to precisely monitor subsurface changes at large scale. The spatial resolution of airgun monitoring is poor subjecting to the receiver distribution. The distributed acoustic sensing (DAS) technique provides a strategy for low-cost and high-density seismic observations. Two experiments combing DAS technique and airgun source were conducted at two sites with different settings. At the first site, a telecommunication fiber-optic cable in urban area was used. After moderate stacking, the airgun signal emerges on the 30-km DAS array at about 9 km epicentral distance. In the second experiment, a 5-km cable was deployed from the airgun source to about 2 km away. About 800-m cable was frozen into the ice above the air-gun, the rest cable was cemented on the road crossing through a fault. And the airgun has been fired continuously for more than 48 hours with one-hour interval. On the stacking multiple shots' records, the wavefield in fault zone emerges too. These two experiments demonstrate the feasibility of using various fiber-optic cables as dense array to acquire air-gun signal in different environments and to monitor the subsurface changes.