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Backward piping erosion detection in levees by fiber optic acoustic sensing

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Backward piping erosion (BEP) is considered the most dangerous failure mode for levees due to its unpredictable nature. This erosive process happens most of the time underneath the impermeable layers on which levees are commonly founded. This makes it very difficult to detect as conventional geophysical methods are either too expensive or too imprecise for real time monitoring of longitudinal soil made structures such as Dams or levees. Fiber optic based distributed acoustic sensing (DAS) is an innovative technology which allows to retrieve information from an acoustic propagating medium in a spatially dense manner by using a fiber optic cable. The present study aimed to explore the potential of DAS for early detection of BEP under levees based on the frictional emissions of the sand grains during the erosive process. The tests were performed in the lab under controlled ambient noise conditions. The technology was tested by embedding fiber optic based microphones underneath and outside a laboratory scaled aquifer set up capable of recreating BEP. The results show that indeed the process emits certain characteristic frequencies which may be located between 1200 to 1600 Hz and that they can easily be captured by the fiber optic cables.