On the applicability of microphone readings for robust event detection in broad-band ambient seismic noise

Steiner, Matthias (Research Group Geophysics, Department of Geodesy and Geoinformation, TU-Wien, Wien, AUT);
Straka, Wolfgang (Institute of Applied Geology, University of Natural Resources and Life Sciences, Wien, AUT);
Flores-Orozco, Adrian (Research Group Geophysics, Department of Geodesy and Geoinformation, TU-Wien, Wien, AUT)

Recent studies in landslide investigations have revealed promising results in the application of seismic noise analysis to delineate hydrogeological processes such as surface water infiltration and groundwater flow. However, the need for flexible monitoring geometries in landslides, where deformation rates could significantly change in space and time, demands the deployment of mobile stations with near-surface sensors which are easier to install and retrieve on a short notice. However, the deployment of mobile stations leads to the contamination of the seismic data due to airborne noise. Thus, the analysis of ambient noise, commonly associated to low signal amplitudes, demands the development of algorithms that permit to differentiate between airborne and seismic events. A commonly used technique for seismic detection is the STA/LTA principle suitable for the detection of local, micro and distant seismic events controlled by adequate parameter settings. However, in case of shallow sensor installations (depth ~ 1 m) its performance is limited, due to irregular manmade seismic signals. Thus, a proper discrimination of subsurface sources and the removal of airborne events are mandatory for an adequate processing of seismic noise. Hence, we present here the application of microphone readings for event detection in broad-band seismic data. Our detection strategy assumes that for shallow installation depths similar waveform behavior and patterns in seismic and microphone data. Seismic events of subsurface origin are detected by means of robust outlier detection in the amplitude ratio computed from those complementary data sets. We evaluate this alternative detection approach using data recorded with Nanometrics Trillium 240 broad-band seismometers and a GRAS 46AE free-field microphone. Both sensor types are connected to Trimble REF TEK 130 broad-band seismic recorders. The detection results are compared to the earthquake catalogue published by the Seismological Service of the Central Institute of Meteorology and Geodynamics (Zentralanstalt für Meteorologie und Geodynamik, ZAMG). With this robust technique, we reliably detect seismic events of varying amplitude which permits a pre-filtering of seismic data to enhance the analysis of ambient seismic noise in landslide studies. We believe that our method is a step forward in the development of automatable algorithms that permit a quasi-real time processing of large seismic datasets.