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Improving Seismic Monitoring in Northern Switzerland

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We currently densify the existing Swiss Digital Seismic Network in northern Switzerland by additional 10 stations. The new network aims at observing seismicity in northern Switzerland with a completeness of $M_c = 1.0$ and a location error < 0.5 km in epicenter and < 2 km in focal depth.

Monitoring of weak seismic events in this region is challenging, because the area of interest is densely populated and geology is dominated by the Swiss molasse basin. A optimal network-design and a thoughtful choice for station-sites is, therefore, mandatory. To help with decision making we developed a multi-step assessment-scheme that takes into account local noise level, geology, infrastructure, and costs necessary to realize the station.

The assessment scheme is weighting the different parameters and the most promising sites are identified. In a first step, all potential sites are classified based on information from topographic maps and site inspection. In a second step, local noise conditions are measured at selected sites. Finally, the most promising sites are classified taking into account results from the test measurements and updated information on local geology, availability of electricity and data transmission, and installation costs.

The first station went into operation in September 2012. In this study, we present lessons learnt during the network realization. We review the proposed assessment-scheme and demonstrate potentials and limitations for seismic monitoring in such an environment.

We find that the step-wise search for the optimum installation site was successful. Test measurements conducted and analyzed for the assessment-scheme are representative for the performance of the later installed stations. In one case a significantly improved installation was possible, because the test measurement revealed noise sources that could be diminished. The assessment scheme allowed to compare station from different regions, which was especially helpful in judging, whether the site condition in sufficient.

In areas of high ambient noise, seismometers were installed in boreholes at about 120 m depth. We present a comparison of ambient noise measurements at the surface and in the borehole to demonstrate the gain in signal-to-noise ratio in the frequency range 1 Hz to 40 Hz.