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Optimizing Site Selection in Urban Areas in Northern Switzerland

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There is a need to observe weak seismic events (M<2) in areas close to potential nuclear-waste repositories or nuclear power plants, in order to analyze the underlying seismo-tectonic processes and estimate their seismic hazard. We are therefore densifying the existing Swiss Digital Seismic Network in northern Switzerland by additional 20 stations. The new network that will be in operation by the end of 2012, 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 step-wise approach to find the optimum network configuration. Our approach is based on standard network optimization techniques regarding the localization error. As a new feature, our approach uses an ambient noise model to compute expected signal-to-noise ratios for a given site. The ambient noise model uses information on land use and major infrastructures such as highways and train lines. We ran a series of network optimizations with increasing number of stations until the requirements regarding localization error and magnitude of completeness are reached.

The resulting network geometry serves as input for the site selection. Site selection is done by using a newly developed 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. We analyze the test measurement with respect to noise amplitude in different frequency bands, transient noise events and earthquake first arrivals. 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.