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Impact of sensor installation techniques on seismic network performance

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The magnitude of completeness (Mc) of a seismic network is determined by a number of factors including station density, self-noise and passband of the sensor used, ambient noise environment and sensor installation method and depth. Sensor installation techniques related to depth are of particular importance due to their impact on overall monitoring network deployment costs. We present a case study which evaluates performance of Trillium Compact Posthole seismometers installed using different methods as well as depths, and evaluate its impact on seismic network operation in terms of the target area of interest average magnitude of completeness in various monitoring applications. We evaluate three sensor installation methods: direct burial in soil at 0.5 m depth, 5 m screwpile and 15 m cemented casing borehole at sites chosen to represent high, medium and low ambient noise environments. In all cases, noise performance improves with depth with noise suppression generally more prominent at higher frequencies but with significant variations from site to site. When extended to overall network performance, the observed noise suppression results in improved (decreased) target area average Mc. However, the extent of the improvement with depth varies significantly, and can be negligible. The increased cost associated with installation at depth uses funds that could be applied to the deployment of additional stations. Using network modelling tools, we compare the improvement in magnitude of completeness and location accuracy associated with increasing installation depth to those associated with increased number of stations. The appropriate strategy is applied on a case-by-case and driven by network-specific performance requirements, deployment constraints and site noise conditions.