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Decay of seismic noise at shallow boreholes: Observations from Groningen.

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Long-term seismic monitoring arrays are often deployed to shallow boreholes to reduce the seismic noise. We investigate noise level decay in shallow boreholes. A large number of publicly available data with such deployment is available at the seismic monitoring array near the town of Groningen, which allows also characterization of the seismic noise decay in shallow boreholes in urban environments. We study noise distribution at 4 sites from this array. Each site includes 5 receivers deployed in shallow vertical boreholes with 50 meters intervals between the surface and 200 m depth. We show there is no difference between noise levels during the summer and winter at the borehole instruments. However, we observe diurnal variation at all depth levels. We also show there are higher noise levels throughout weekdays and lower during weekends and state holidays. These changes are not only observed at the surface but also at the deepest receivers. This implies that the dominant source of this noise is anthropogenic and it penetrates to depths of 200 meters even at frequencies exceeding 5 Hz. This observation is contradicting the common assumption that the seismic noise consists of the surface waves.