Crustal thickness in central Europe from single-station seismic noise autocorrelation analysis

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The InSight mission to Mars will place a single three-component seismometer on the planet's surface, requiring the application of single-station methods. In addition, seismicity on Mars is likely less abundant than on Earth, making it important to also use the available seismic noise. For these reasons different approaches of seismic noise autocorrelation have been tested with broadband three-component datasets from 12 stations across central Europe. These stations cover varying Moho depths of ca. 25-50 km depth. With the help of the autocorrelations, reflected body waves are extracted in order to estimate the crustal thickness at each station. This is of special relevance for Mars, where average crustal thickness is uncertain by a factor of two.

The different approaches used are waterlevel normalized autocorrelation, with and without application of a short-term and long-term average filter to the spectrum of the data prior to autocorrelation, and phase autocorrelation. These approaches are compared and analyzed. Estimates for the Moho depths are made from the lag times of the reflected P-waves and compared to available Moho depth values at the stations. Due to the availability of three-component data these estimates can be cross-validated and in some cases not only P-wave reflections, but also possible S-wave and multiple reflections can be identified. The estimates compare well with the general trend of Moho depth expected for these stations. The consistency of results is further investigated by comparing different stations of the GERES array (aperture 2 km), which also allows to examine results for closely located broad-band and short-period stations side by side.