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First results of seismic noise cross-correlations between Romanian permanent broadband network and temporary stations deployed in the western part of Romania

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It is possible to retrieve the local seismic propagation properties by cross-correlation of ambient seismic noise records at two sensors. In the present project we combine noise data recorded by 34 Romanian permanent broadband seismological stations with noise data from 33 temporary broadband stations deployed in the western part of Romania within the South Carpathian Project (SCP). The first dataset consists of 2 years (2009, 2010) of continuous recordings, while for the second the data are recorded between July 2009 and September 2010. We compute noise cross-correlations between more than 2000 station pairs for the vertical (ZZ) component of the cross-correlation tensor. To reduce the influence of earthquake-related signals on cross-correlations the day traces are processed in 23 one-hour segments starting at 00:30 and ending at 23:30 to avoid possible data loss at the beginning and end of the day due to the start and end time of the original raw data. The one-hour segments are spectrally whitened to produce a flat amplitude spectrum in the 0.02–5 Hz band. All 23 one-hour cross correlations are stacked to create a day cross correlation and all available day stacks for a given station pair are stacked to produce the empirical Green's functions. If the seismic noise was isotropic, the Green's function would show symmetry around t=0. Such symmetry is present in some cases, especially for longest periods (> 20 s). To get the 'symmetric' component of the Green's function we average the positive and negative parts of the cross-correlation. The analysis of the 'symmetric' cross-correlations shows that it is possible to identify a wave which is coherent over the whole distance range, in the period range 6-30 s. As the vertical components of ambient noise are cross-correlated, this wave is identified as the fundamental mode of the Rayleigh wave. Frequency-time analysis (FTAN) is used to extract the group velocities of the estimated dispersive waves. For five permanent stations it was possible to check the variability of the cross-correlations over a 5 year period (2006-2010). We perform the analysis for the two spectral bands corresponding to the primary (10-20 s) and secondary (5-10 s) microseism and also for the 20-30 s band. We observe no variations from one year to another though smaller amplitudes are obtained for the noise cross-correlations during the summer time (April-September) than for the winter time (October-March), indicating the stability of the noise sources over time. Finally, we present the first results of surface wave tomography in western Romania obtained from the measurements of group velocity of the fundamental mode Rayleigh waves.