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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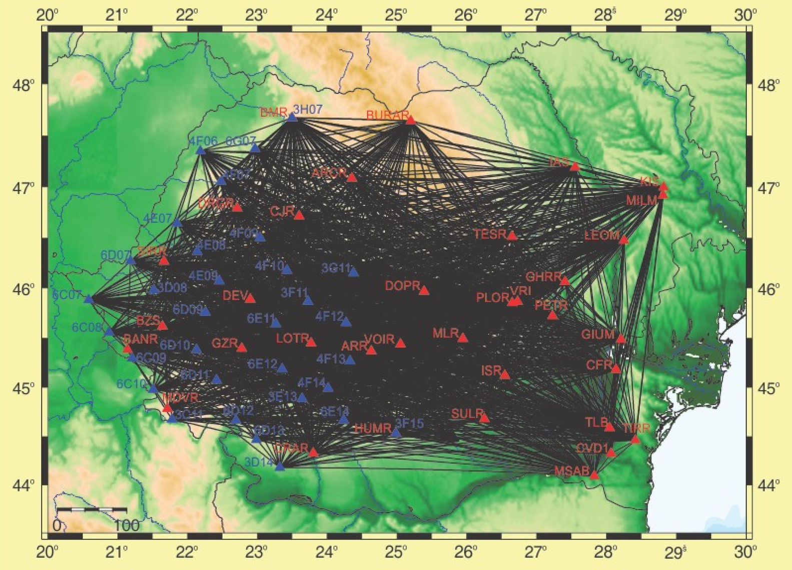
INTRODUCTION

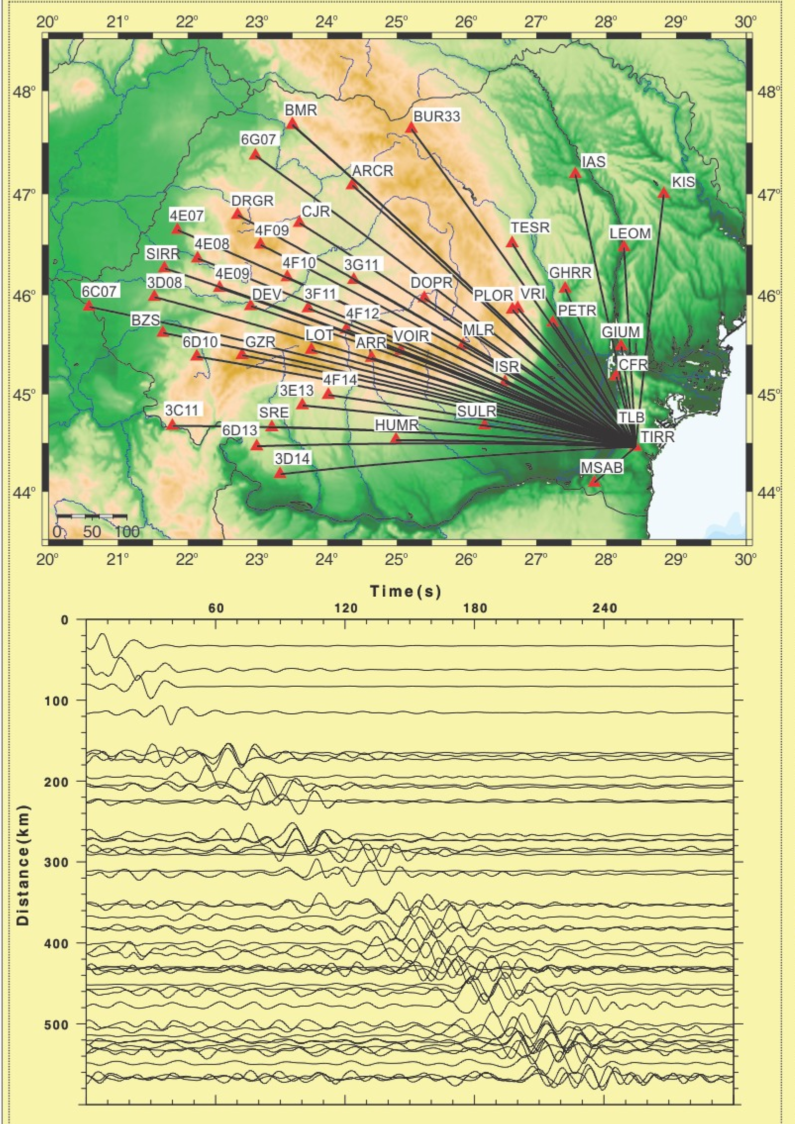
In the last years, it has been shown that is possible to extract part of the Green's function between two stations through cross-correlation of the ambient noise seismic records. In the present study we combine noise data recorded by 34 Romanian permanent broadband seismological stations with noise data from 32 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.

DATA PROCESSING AND RESULTS

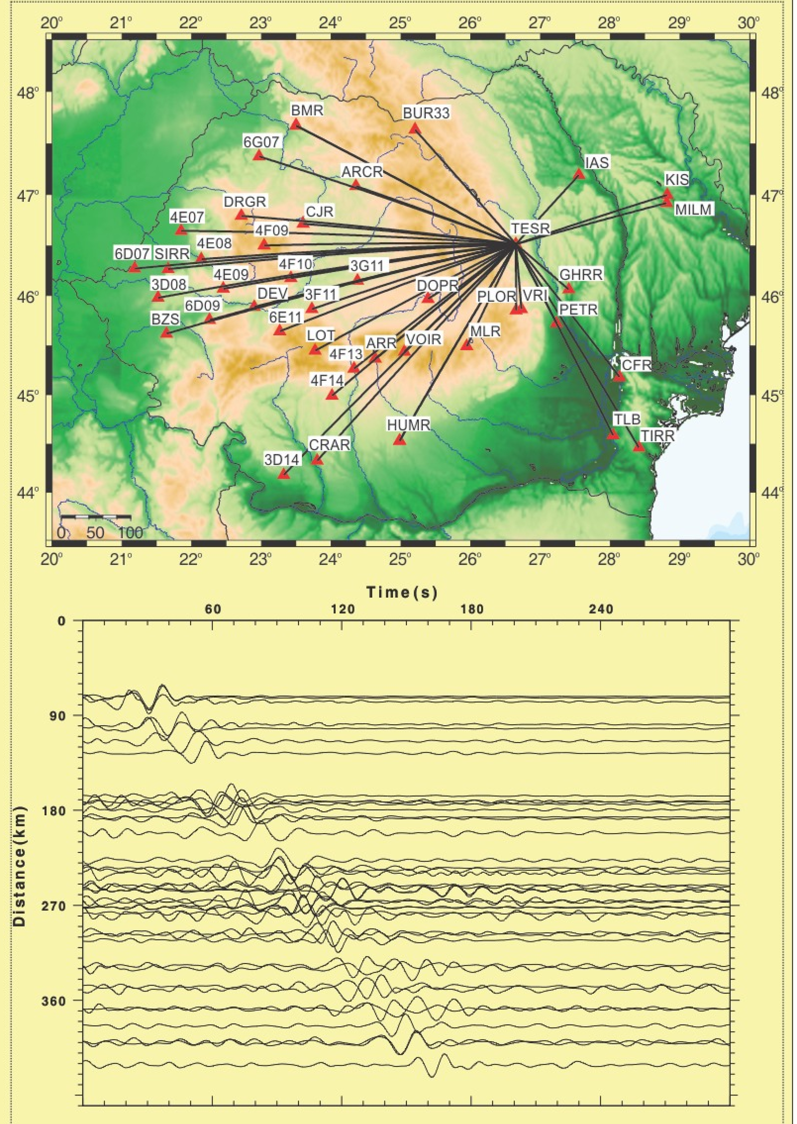


Romanian broadband seismic stations (red triangles) and SCP stations (blue triangles). All possible intercorrelations (2210 - black lines)

- day traces processed in 23 one-hour segments starting at 00:30 and ending at 23:30;
- one-hour segments spectrally whitened to produce a flat amplitude spectrum in the 0.02 - 1 Hz band;
- all 23 one-hour cross correlations stacked to create a day cross correlation;
- all available day stacks for a given station pair stacked to produce the empirical Green's functions;
- we find asymmetric Green's functions;
- 'symmetric' Green's function = averaging of the positive and negative parts of the cross-correlattions.



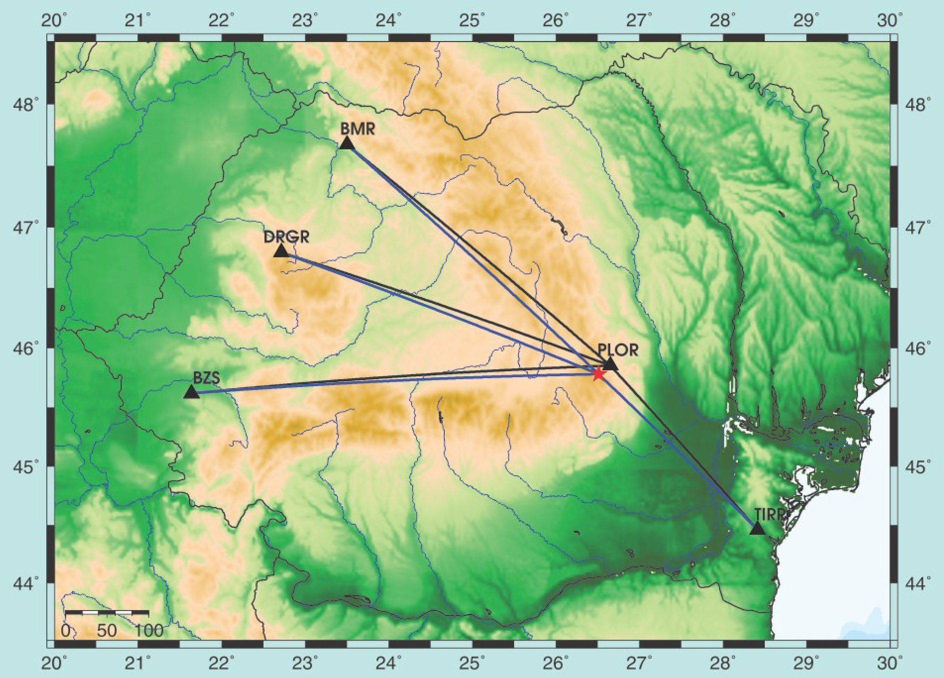
Distance versus time cross-correlations computed for pair of stations centred in TIRR station for the frequency band 0.03-0.1 Hz

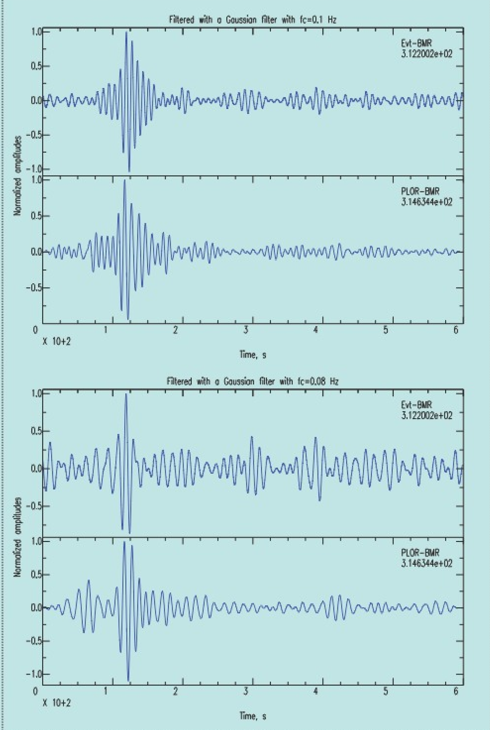


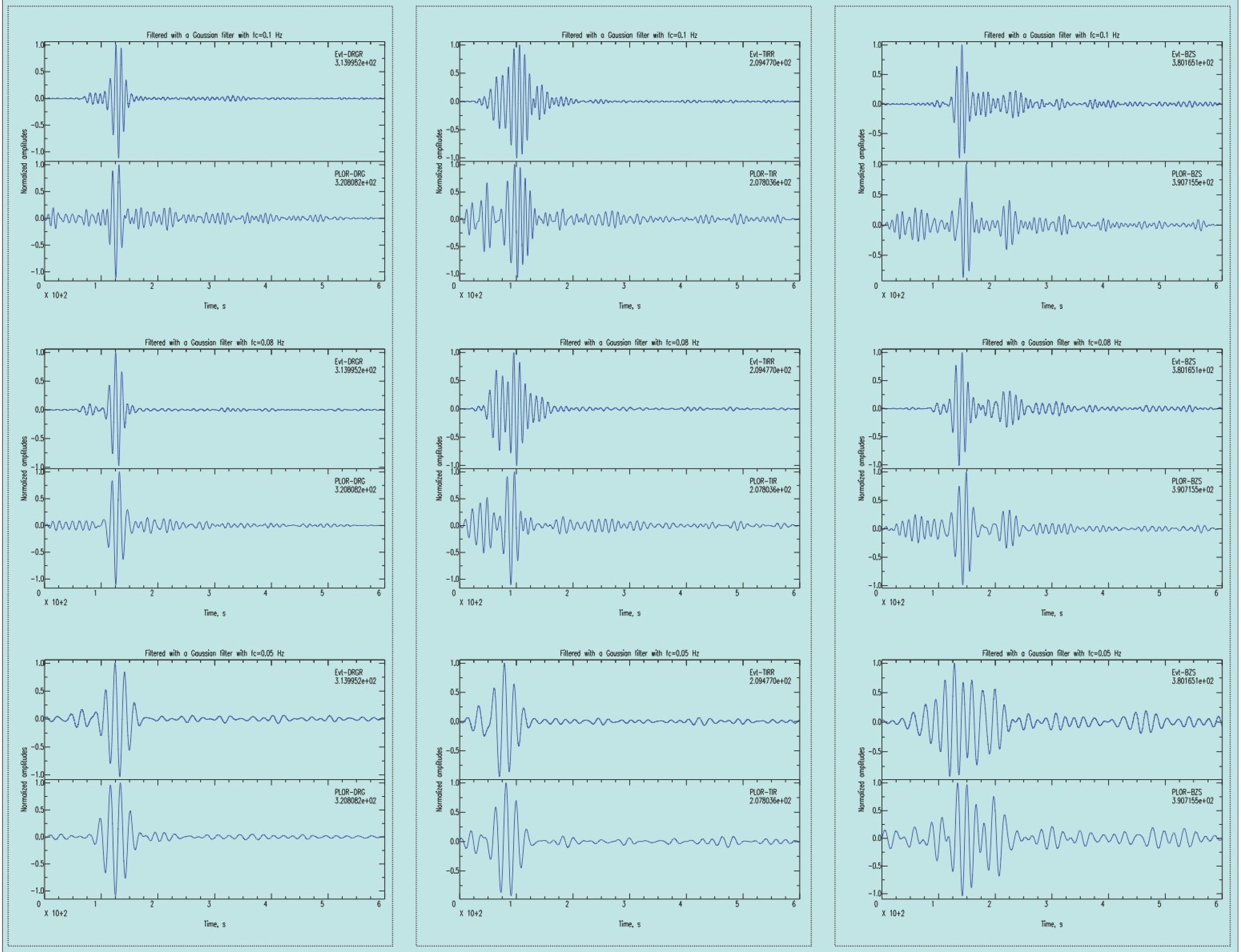
Distance versus time cross-correlations computed for pair of stations centred in TESR station for the frequency band 0.03-0.1 Hz

ESTIMATED GREEN'S FUNCTIONS AND THE SURFACE WAVES GENERATED BY EARTHQUAKES

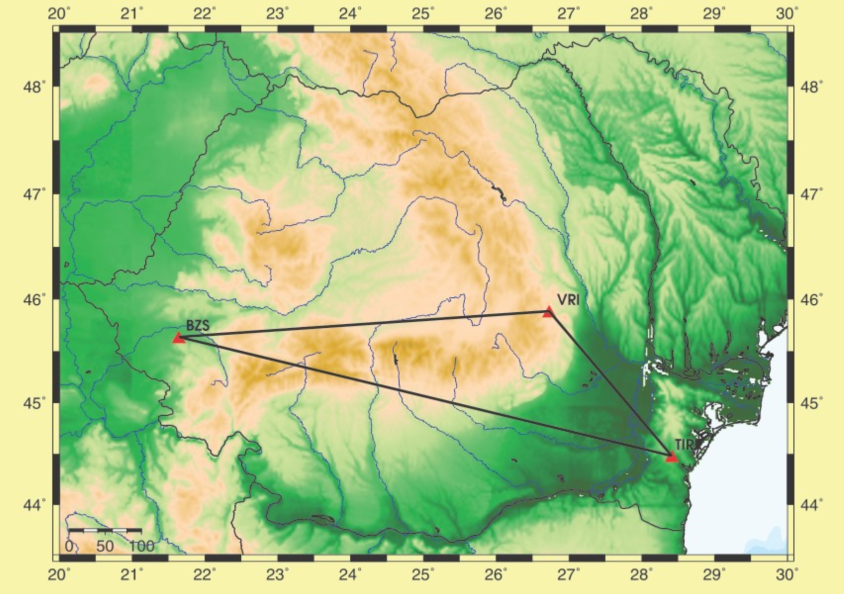
- comparison of the 'symmetric' Green's functions obtained for station pairs **PLOR-BMR**, **PLOR-BZS**, **PLOR-DRGR** and **PLOR-TIRR** with the surface waves generated by a Mw = 3.4 earthquake occurred on September 6, 2008 near PLOR station (red star) at a depth of 12 Km
- amplitudes normalized to their maximum value;
- signals filtered with a Gaussian filter with different corner frequencies: 0.1 Hz, 0.08 Hz and 0.05 Hz, respectively.



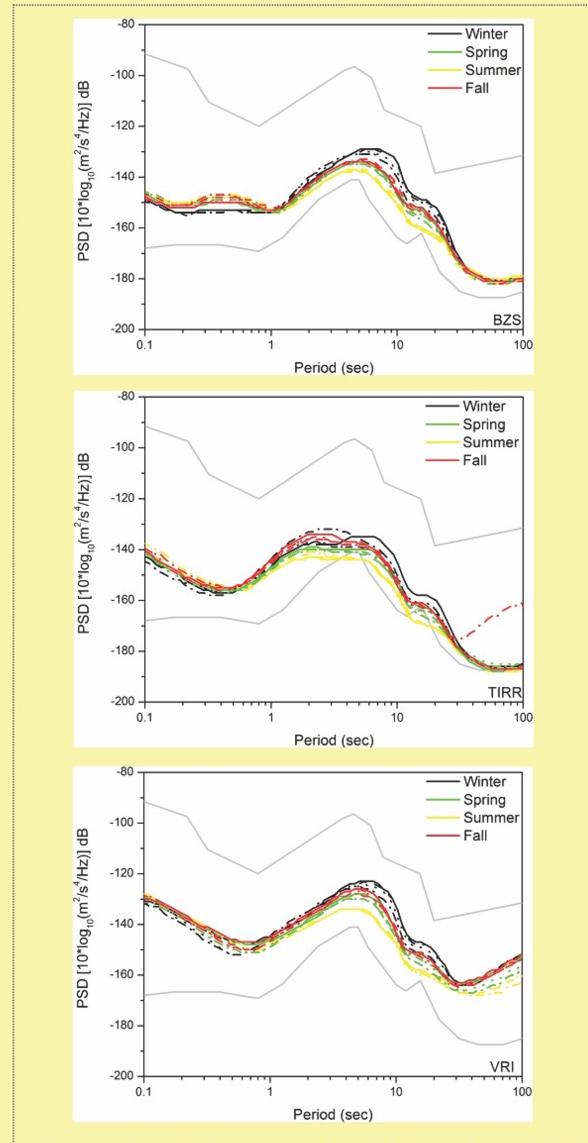




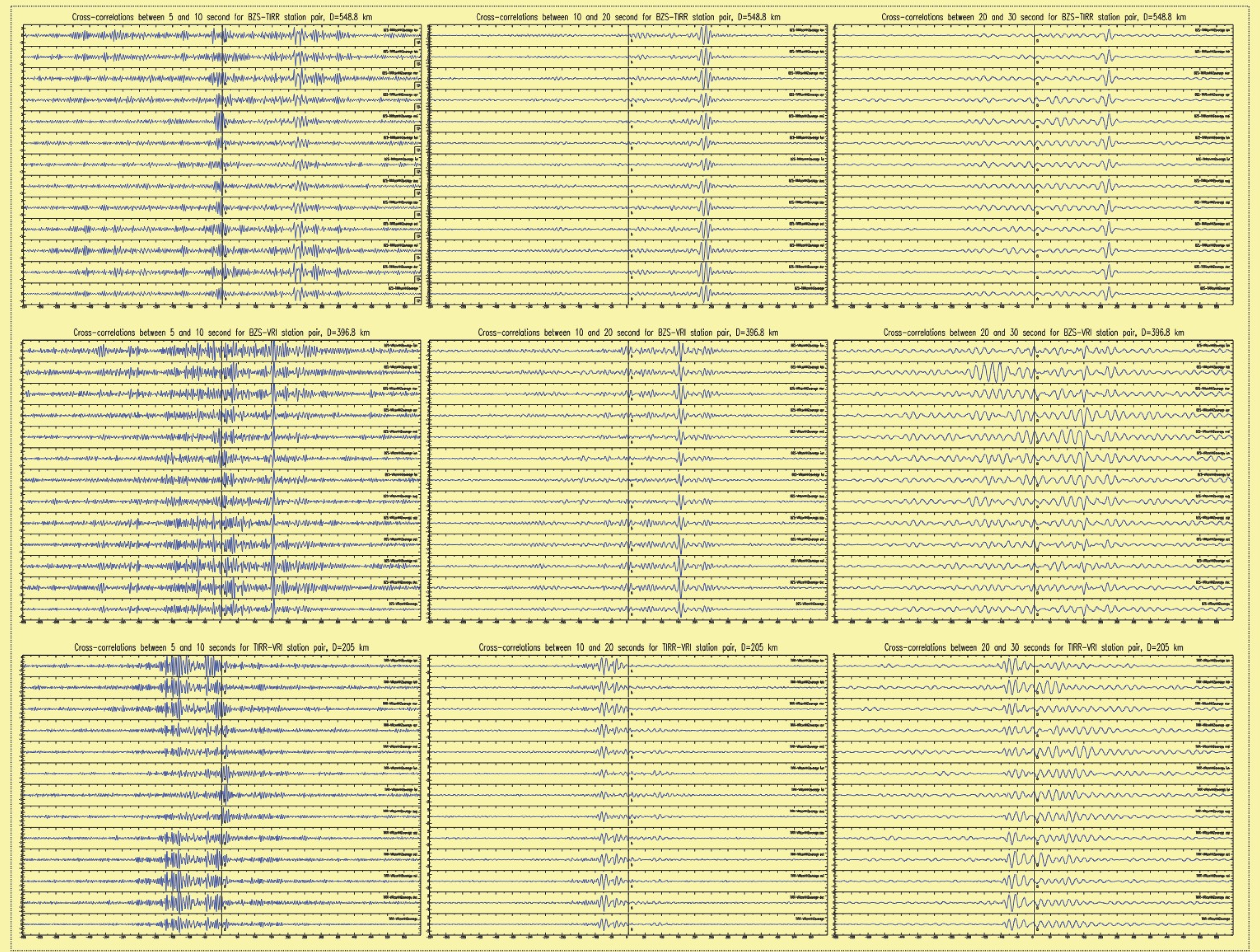
VARIABILITY OF CROSS-CORRELATIONS



- variability of the cross-correlations over a 5 year period (2006-2010);
- the analysis is performed for two spectral bands corresponding to the primary (10-20 s) and secondary (5-10 s) microseism and also for the 20-30 s band;
- cross-correlations are stacked per months (firsts 12 waveforms) and over the 5 year period (the last waveform) (figures below) -> some variations in amplitudes during the April-September period;
- computation of the median noise levels for periods of three months, from December 2006 to November 2010 (figures on the right) -> increase of the noise level during winter months in the microseismic band (1-20 s).

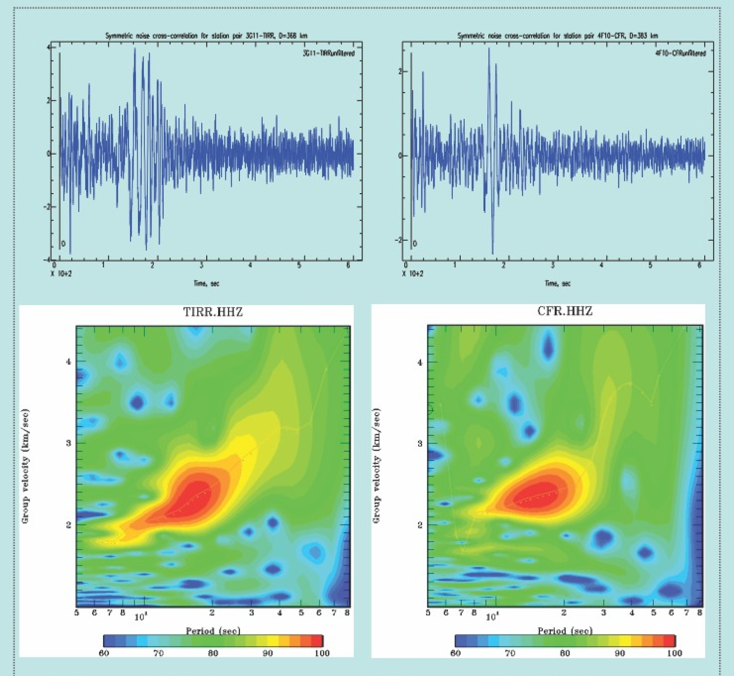


Seasonal variations at stations BZS, TIRR and VRI

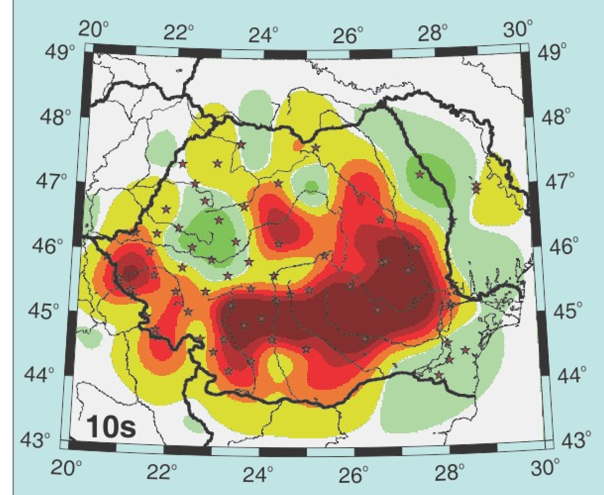


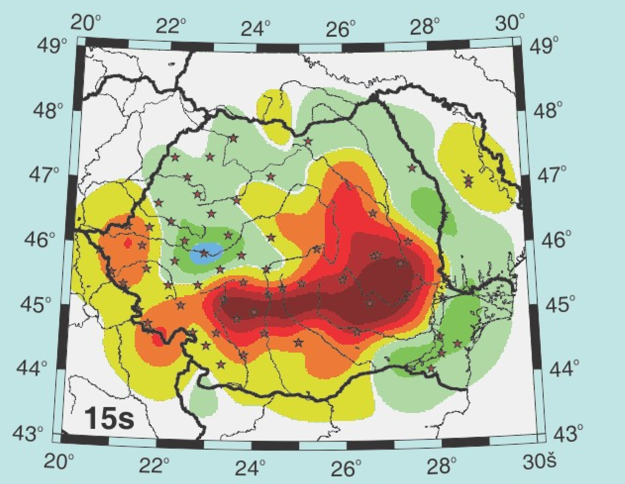
PRELIMINARY RESULTS OF THE AMBIENT NOISE TOMOGRAPHY

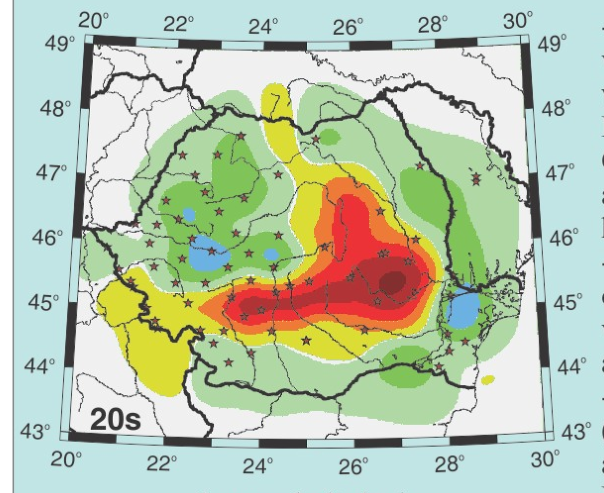
- FTAN analysis to unfiltered signals in order to determine the group velocities curves;
- traveltimes derived from group velocities;
- FMST software package is used for traveltime tomography;
- the Fast Marching Method (FMM) (Rawlinson and Sambridge, 2004) is used for forward problem;
- a subspace inversion scheme is used for the inversion step;
- the study are is divided into 0.4° x 0.5° grids with a constant initial velocity of 2.8 km/s. No a priori information is added into the model.



'Symmetric' noise cross-correlations and FTAN maps for 3G11-TIRR and 4F10-CFR station pairs







- the Rayleigh-wave group velocity map at 10s show lower velocities in front of SE and S Carpathians, mainly for deeper basins with thick piles of sediments (low velocity) and in Transilvania and Pannonian (Banat) basins. Higher velocities are in the foreland of Carpathians (SE of Moesian and Moldavian/Scythian platforms) but also in Apuseni Mountains (mainly for S Apuseni - Metaliferi Mts having large ophiolites nappes with deep roots and high velocity).
- the map at 15s shows that previous low velocities areas get smaller outlining the contour of deeper basins and in the same time the higher velocity areas are better expressed in Apuseni Mts and in the foreland areas of the SE Carpathians (Dobrogea and central Moldavia).
- for the map at 20 s the lower velocity zones are more diminished (Focsani basin and S Carpathians foredeep) while the higher velocity areas are more stretched and better outlined (ophiolites in S of Apuseni Mts and in basement of Transilvania basin as well as North Dobrogea Orogen). This structural pattern is supported by two regional refraction seismic lines Vrancea 99 and Vrancea 2001 (Hauser et al., 2001, 2007) which display low P-wave velocity in Focsani basin (ca 18 km of sediments/9 km thickness of Neogene pile) and high velocity in North Dobrogea orogen crust .

Acknowledgements

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