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MULTIPLE ARRAY APPROACH FOR STUDYING SURFACE WAVE PROPAGATION AND ESTIMATING LOCAL STRUCTURES

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Traditional approaches to surface wave analysis suffer from several issues. Measuring group velocities, we may obtain structural information between source and receivers that provides only average velocities without local information. Measuring phase velocities by the two-station method focuses on a particular region, however, the lack of information concerning true propagation paths and backazimuths makes this measurement less reliable. The proposed array approach provides measurement of the phase velocity vector for each period by estimating both magnitude of the velocity and its azimuth. Firstly, records from all stations are decomposed into harmonic components. Multiple filtering technique as a standard method of the Fourier transform-based frequency-time analysis is used. The spectrum of the record is multiplied by weighting functions centered at many discrete frequencies and harmonic components are obtained by the inverse Fourier transform.

Then, any of the stations serves as a centre of the array of the neighboring stations. Harmonic components of records from the neighboring stations are correlated with the central one and the time differences are used to compute the local phase velocity as well as the true backazimuths of propagation for each period of the surface waves. By correlating different time windows of records, we may observe the velocities and propagation backazimuths of different modes of surface waves. When we move behind the fundamental mode wavegroup, we observe coherent signals coming from different directions as surface waves reflect and scatter at inhomogeneities.

This array approach is used for estimating surface wave propagation paths across Central Europe in the period range of 10 to 60 s identifying fundamental mode propagation from the earthquakes in the Aegean Sea as well as reflections from Tornquist-Teisseyre zone. Data from the ORFEUS database and PASSEQ experiment are also used.

Local phase velocity dispersion curves obtained by the array method are than inverted for 1D local shear wave velocity model. Through combining surface waves propagating from different directions and processing all three components, effective local anisotropy may be revealed. We apply the method for upper crust structural studies in the region of eastern Czech Republic (30 x 30 km) using local events and surface waves in the range from 0.5 to 3.0 s.The figure shows a map of the Bohemian Massif. Vertical component record of the fundamental mode of an earthquake from the Aegean Sea is analyzed. The color scale represents periods, the length of the vector represents the magnitude of the velocity and the directions show the backazimuths of surface wave propagation. The number following the station name indicates how many stations are used for correlation for the particular central station. Neighboring stations for each central station are selected in a distance from 40 to 120 km in the example.