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Automated inter-station measurements of fundamental mode phase velocities, and tomographic inversion for Central and Northern Europe

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Broad-band phase velocity measurements of fundamental mode surface waves yield information on the isotropic as well as anisotropic structure of the crust and the upper mantle. Dispersion curves may be determined by cross correlating direct and coda fundamental mode waveforms recorded at two stations on the great circle path. In many cases the cross correlation is less affected by scattering than the waveform itself. Examples show that broad band dispersion curves may be obtained by this interferometric measurement. Single event measurements may however be perturbed by off-path propagation, scattering at lateral heterogeneity, higher modes, noise, and erroneous response information. Due to the smooth nature of the 1D fundamental mode sensitivity kernels smooth dispersion curves are expected for media with moderate and smooth lateral heterogeneity. Therefore, smooth parts of the dispersion curves are selected. This reduces the influence of scattering, higher modes, and noise. Furthermore, comparison of a large number of dispersion curves measured along one path for both propagation directions may reveal smooth perturbations caused by off-path propagation and erroneous response information. Finally, after rejection of outliers smooth measurements for a larger number of events are averaged to find a path-average dispersion curve. Previously, the selection of the smooth part of the dispersion curve was made manually and if there were many station pair combinations and a large number of events the manual processing was time consuming. We now introduce the automated selection of the phase velocity curves, based on a set of rigorous, consistent, frequency- and distance-dependent criteria. The procedure is applied to around one million events and about 60,000 paths on permanent and temporary networks including TOR, and PASSEQ networks in central and northern Europe. Fundamental mode Rayleigh and Love wave dispersion curves are measured and anisotropic phase-velocity maps are then calculated for periods between 10 and 200 seconds. At 15-s period, pronounced low velocity anomalies delimit the deep sedimentary basins in north- Central Europe and around the Alps. The Trans-European Suture zone as a sharp transition from lower to higher velocities is becoming the dominant structure at longer periods (60 and 125 s) which are sensitive to upper mantle depths.