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# Controlled-Source Seismic Tomography with Wavelets: Inversion Algorithm and its Application to Vesuvius Volcano

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A self-adaptive automated parameterisation approach is suggested for the inversion of controlled-source seismic tomography data. The velocities and interfaces are parameterized by their Haar wavelet expansion coefficients. Only those coefficients that are well constrained by the data, as measured by the number of rays that cross the corresponding wavelet function support area (hit counts) and their angular coverage, are inverted for, others are set to zero. The adequacy of the suggested empirical resolution measures are investigated on the 2D and 3D synthetic examples by the comparision with the corresponding diagonal elements of the resolution matrices. The rule for the optimal selection of algoritm parameters has been constructed. We show with the series of the synthetic tests that our approach leads to the reasonable distribution of resolution throughout the model even in cases of irregular ray coverage and helps to overcome the trade-off between different types of model parameters.
The developed algorithm has been used for the construction of the Vesuvius volcano area velocity model based on the TOMOVES experiment data. The described algorithm allows to obtain the multi-resolution model that provide fine structure information in well-sampled areas and a smooth generalized pattern in other parts of the model. Layer-stripping as well as whole-model approaches were applied to the same data set in order to test the stability of the inversion results. Key features of the model (high-velocity body at depthś -1.2 - 1.0 km under the volcano edifice and a low-velocity volcano root in the carbonate basement, low-velocity basins at the volcano flanks and general position of the carbonate basement top at 1-2 km depth) remain stable regardless of the inversion approach used. Our model well agrees with the previous studies particularly in the structure of the upper volcano-sedimentary layer but provides more fine details and reveals additional structures at greater depthś.