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Differentiated inversion as an advance to construct realistic seismic images

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The seismic observation responds to nature's phenomena and there is no chance to repeat the measurement. The nontrivial combination of various kinds of errors of observation (measurement, modeling and linearization) can not be accurately clarified. To satisfy all equations of linear system the standard approach estimates the defined parameter with the help of the integrated contribution of all possible seismic rays with their unknown errors. Thus the standard method can work adapting to these errors. To decrease the probability of erroneous inversion outcome it is proposed to differentiate seismic rays into subsystems, each of which is formed by the separated station and by the cluster of seismic activity so that participating seismic rays pass through the same cells of media. Consequently the set of filled subsystems of small size should be solved instead of the inversion of the whole large and sparse matrix. To get the unique numerical solution of the separated subsystem we select nonsingular part of the matrix in accordance with the advanced algebraic and statistical criteria. In that way the procedure of least squares (lsq) is changed to Gauss's direct proximate method. The solution, which was found for the separated subsystem contributes to the defined parameter from the corresponding azimuth orientation. By means of the comparable analyze of values from different orientations we establish objectively realistic evaluation for the given parameter. From numerical point of view the algorithm is derived by Gauss's procedure of elimination of unknowns. However each unknown is seek as the most reliable regular estimate in agreement with Tichonov's regularization. Using the simple synthetic examples it is demonstrated that the presented approach works better than the standard lsq method. The application to the synthetic and real data of West-

ern Nagano fault area (Japan) shows obvious advantage of new inversion algorithm in comparison with the LSQR and the DD tomography, which are based on the lsq. Presently the differentiated inversion is developed for travel time tomography. Also it can be extended for amplitude tomography and for any branches of geophysics, where the similar observation system of linear equations can appear.