Two dimensional refraction inversion by progressive model development

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We develop a systematic approach for the analysis of 2-D refraction experiments which can improve velocity structure models progressively through a sequence from 1-D models to pseudo 2-D models, and then 2-D models. We use Genetic algorithm inversion, a turning point approximation, and a Bayesian formulation of non-linear iterative inversion to develop models progressively. The approach consists of four steps. All the steps exploit first arrival travel time data and do not use any trial-and-error forward modelling. The approach enables a complex inversion to be undertaken in 1 or 2 days.

We develop a systematic approach for the analysis of two-dimensional (2-D) refraction experiments which can improve velocity structure models progressively through a sequence from one-dimensional (1-D) models to pseudo 2-D models, and then 2-D models. The approach consists of four steps. Firstly, 1-D velocity models are constructed for each segment of the profile using Genetic algorithm inversion, and pseudo 2-D models are constructed using a turning point approximation. The purpose of this step is to provide an approximate image of 2-D velocity structure, and to infer the number and general location of layer boundaries. Step 2 uses 1-D layered modelling with again a pseudo 2-D conversion, which generates a rough 2-D layered structure. The third step consists of smoothing the pseudo 2-D model in order to create initial models for use in 2-D inversion. The fourth step is the construction of a 2-D model using a Bayesian formulation of non-linear iterative inversion. All the steps exploit first arrival travel time data and do not use any trial-and-error forward modelling. This approach is efficient because it uses the results of each step as the initial model for the next step. The method is applied to real data from an along-strike experiment and also to a related synthetic example so that the quality of the solution can be judged. The results indicate that the method is robust and this is confirmed by a further synthetic example which represents a survey across a trench and dipping subduction zone. The systematic approach to the inversion of refraction data enables a complex inversion to be undertaken in 1 or 2 days. The sequential approach allows the incorporation of additional information if desired.