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An estimation of the uncertainties in layered models based on travel times inversion.

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Inversion of travel times is a common way of modelling of the crystalline crust. Quite often it is done manually by trial and error method. In this case it is very difficult to estimate the uncertainty of obtained models. Proposed is an analytical method based on a simple principle of error propagation that will allow the estimation of the uncertainties. Two variants of the method are presented: a simplified one that includes refraction and vertical reflections and the one that includes also wide-angle reflections. Both give a quantitative estimation. To allow for a simple analytical estimation, refracted waves are described using a head-wave approximation in constant velocity layers; wide angle reflection paths are also simplified.

This technique works only for the final models, where all travel times are optimally fitted. That assures the optimal rays shape, and makes used rays approximation valid. When analysing optimal solution state it is possible to use also statistical methods to analyse parameters sensitivity around this state. Those calculations gives similar results confirming used approximations.

This technique can also be applied to models obtained by inversion, especially using layer-stripping modelling strategy. It will evaluate propagation errors commonly excluded in this type of modelling.

An example of application of this method is presented for both simple synthetic case and the model based on the field data. For complicated cases the uncertainties for deep layers and interfaces will be larger comparing to commonly used values based on a single parameter sensitivity tests.