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Bayesian approach to seismic traveltime tomography: developments for the simulr16 package.

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A meaningful interpretation of seismic measurements requires a rigorous quantification of the uncertainty. We are developing a technique that allows a quantitative estimation of the uncertainty in seismic traveltime tomography. A bayesian algorithm has been included in the existing simulr16 code in order to allow the inversion of reflection-refraction data also with a probabilistic approach, obtaining as a solution an ensemble of models. The probability distribution for the inverse parameters in this ensamble contains much more informations than a single deterministic solution model and allows a quantitative assessment of model parameters uncertainty. A bayesian inversion can be performed to test an existing deterministic solution or as a standalone inversion. We allowed the inverse problem to be treated also in a transdimensional framework, where the dimension of the model space is a variable; the parametrization of the model space is in this way determined by the data itself and not by deterministic constrains. The level of information contained in the data drives the sampling process of the model space removing from the inversion parameter poorly constrained nodes. The actual stage of the methodology is tested, and some preliminary results are shown with a synthetic example and with a refraction seismic dataset from Wimbachtal (Austria). Some future directions in the developing process of this algorithm are presented: in order to increase the acceptance ratio of sampled models, we will use the off-diagonal elements of the resolution matrix to obtain a set of trade-off relations between different inverse parameters. Having a quantitative value to describe the intercorrelation between parameters will compensate global biasing effects of a random perturbation, allowing also to increase the magnitude of perturbations, finally resulting in a more efficient sampling of the prior model space.