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微気圧・地震データ同化によって推定されたモデルパラメータの事後分布

Evaluation of posterior distributions of model parameters obtained by data assimilation of infrasound and seismic data

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Inversion techniques have been playing major roles in various fields of geophysics in a few decades for the purpose to clarify spatial structures and its temporal variation of targets of interest. Not only a determination of optimum model parameters but also a numerical evaluation of the determined parameters is very important in order to check the validity of the assumed model and subsequently to construct a better model. However such an evaluation is often insufficient owing to a bother programming and enormous computation time.

Here we propose a procedure to evaluate posterior distributions, i.e., a probability distribution function of model parameters when observation data are given, which is thought to be applicable in wide area of geophysics. As an example, we carry out a data assimilation on infrasound and seismic waves excited by the 2008 Iwate-Miyagi Nairiku Earthquake (Nagao et al. [2008]). First we calculate a set of eigenfunctions of normal modes (Kobayashi [2007]) related to a one-dimensional coupled model consisting of the solid Earth (PREM; Dziewonski and Anderson [1981]) and the atmosphere (NRLMSISE-00; Picone et al. [2002]). Then we apply a sequential Monte Carlo (SMC) method such as the particle filter algorithm to a combination of simulated waves derived from the eigenfunctions and observed data obtained at F-NET seismic observatories and CTBTO Isumi microbarometer array, and estimate not only optimum value but also posterior distribution for each model parameter such as components of a moment tensor, rupture length and velocity, and velocity structure in the atmosphere. The posterior distributions can be obtained by the adaptive direction sampling, which is based on the Markov Chain Monte Carle (MCMC) method, plugged-in to the particle filter code. The obtained posterior distributions could give us information such as dominant/non-dominant parameters, confidence interval of relevant parameter, and modeling errors. We especially discuss on how the infrasound data contributes to the determination of posterior distributions comparing with the seismogram.

キーワード: CTBT微気圧データ,岩手・宮城内陸地震,ノーマルモード,事後分布,粒子フィルタ,マルコフ連鎖モンテカルロ法

Keywords: CTBT infrasound data, Iwate-Miyagi Nairiku Earthquake, normal mode, posterior distribution, particle filter, Markov Chain Monte Carlo method