Development of seismic inversion tool for flat and isotropic layered structures in the ocean (SEIS-FILO)

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Seismological studies have approximated the Earth’ s structure using the stratification of flat and isotropic layers. Such one-dimensional models are suitable for single-station measurements, including receiver functions, surface wave dispersion curves, and H/V ratios, and have been widely used to illuminate a wide range of structures from shallow basin to deep mantle structures. Recently a growing number of studies come to use more sophisticated methods (e.g., full-waveform inversion) for modeling laterally heterogeneous structures of the Earth. Nevertheless, the modeling by one-dimensional structure will not lose its position because of the less computational cost and no need for dense seismic instrument deployments. Especially for the ocean area, insufficient coverage by station networks will force to use such single-station methods.

Here, I present a computer program package termed SEIS-FILO (seismic inversion tool for flat and isotropic layered structures in the ocean). The software performs transdimensional inversion of receiver functions and surface wave dispersion curves, with the effects of the seawater column fully considered. The state-of-the-art Bayesian probabilistic sampling method known as reversible-jump Markov-chain Monte Carlo is used, where the number of model parameters (i.e., the number of layers) is automatically selected based on the data complexity. The parallel tempering technique is also implemented to enhance the conversion rate. The source codes are written in a modern Fortran programming style (i.e., objective-oriented programming) for a low-maintenance and easy expansion in the future.

Currently, the software undergoes alpha testing: independent/joint inversions of receiver functions and fundamental Rayleigh wave dispersion curves are possible to perform. This alpha version is available at the GitHub repository (https://github.com/akuhara/SEIS_FILO).

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