



Combining full waveform inversion and traveltimes tomography

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By alternating full waveform inversion and traveltimes tomography we attempt to merge their complementary merits and produce models of the European continent explaining both waveform and traveltimes data sets.

Technological developments and advances in theoretical and numerical seismology allow us to assimilate complete waveforms for the solution of full waveform tomographic problems. However, due to computational limitations, full waveform inversion is and will, in the long term, be limited to an intermediate period band. Valuable information contained in high-frequency P and S wave traveltimes cannot be exploited. Consequently, full waveform inversion only yields excellent results in the upper 300 km, where surface wave sensitivity is large. P and S velocity heterogeneities at greater depth are less well resolved. On the contrary, classical traveltimes tomography intrinsically incorporates information from high-frequency body waves.

As an initial step to combine both methods and extend the spectrum of exploited information, we test an inversion scheme, where full waveform inversion and ray tomography alternate, thereby avoiding an explicit coupling of both methods and data sets. We put special emphasis on the convergence properties of this scheme and its ability to produce 3D models that explain both waveform and traveltimes data sets. We test our approach starting with a full waveform tomographic model of Europe and Western Asia in conjunction with the traveltimes tomography package FMTOMO and the teleseismic data set used for the construction of the global model S40RTS.