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Resolution tests of global geodynamic models by travel-time tomography

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We present results of a tomographic inversion of synthetic data that examines the ability of seismic tomography to reveal structures created by mantle dynamic processes. We have performed the calculations in both 2-D and 3-D geometry. In 2-D our seismic velocity anomaly model is based on the density heterogeneities obtained from models of thermal and thermo-chemical convection. Both layered and whole-mantle models are employed to produce the synthetic input anomalies. In 3-D the synthetic input model is constructed using reconstructions of subduction lines positions. We investigate the resolving power of the inversion of P and PP arrival-times, and assess the influence of parameterisation and regularisation (damping). We show that the effect of regularisation is substantial and that the optimum damping depends upon the wavelength of the input structures. The resolution of both seismically slow and fast structures is good in the upper mantle. In the lower mantle, at the depths higher than about 1000 km, the resolving power is rather poor. We are able to map both horizontal and vertical long wavelength structures there. On the other hand, narrow vertical anomalies are often undetectable. Since the resolution of the inversion decreases considerably at depths greater than 1000 km, the ability of the kinematic inversion to distinguish between whole-mantle and layered flows (coupled via thermal coupling) may be limited and certain care is necessary when interpreting the output of real data tomographic inversion.