



Nested Regional Tomography with 3-D ray tracing

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A new style of seismic tomography is proposed employing nested regional grids embedded in a fixed 3-D global model. Full 3-D ray tracing is applied at each stage, with updates of the regional structure. This approach has been applied to the East Asian and Australasian region with initially a 1×1 degree grid with 19 layers in depth down to 1500 km. For events or stations outside the region summary rays defined on 0.5×0.5 degree grids are employed, but all rays are included when the source and receiver lie within the zone. Both model damping and smoothing are employed and the iterative inversion is carried out with the CGLS algorithm with recalculation of the rays at each linearised step.

After a couple of iterations, when a stable result has been achieved, we switch to a smaller inner domain with 0.5×0.5 degree cells. The wavespeed structure in the outer regional zone is now fixed, and the non-linear inversion is confined to the high resolution zone, which we have focussed on the Indonesian region.

Recovery tests with both checkerboard and synthetic slab models indicate good recovery for high wavespeed anomalies. The tendency of first arriving ray paths to avoid zones of lowered velocity means that such features are suppressed when iterative 3-D ray tracing is applied.

The new procedure provides good definition of the patterns of variation in seismic wavespeeds and minimises edge-effects between detailed and more coarsely represented zones. The inner domain can be readily moved inside the broad regional model allowing attention to be focussed on different aspects of the structure.