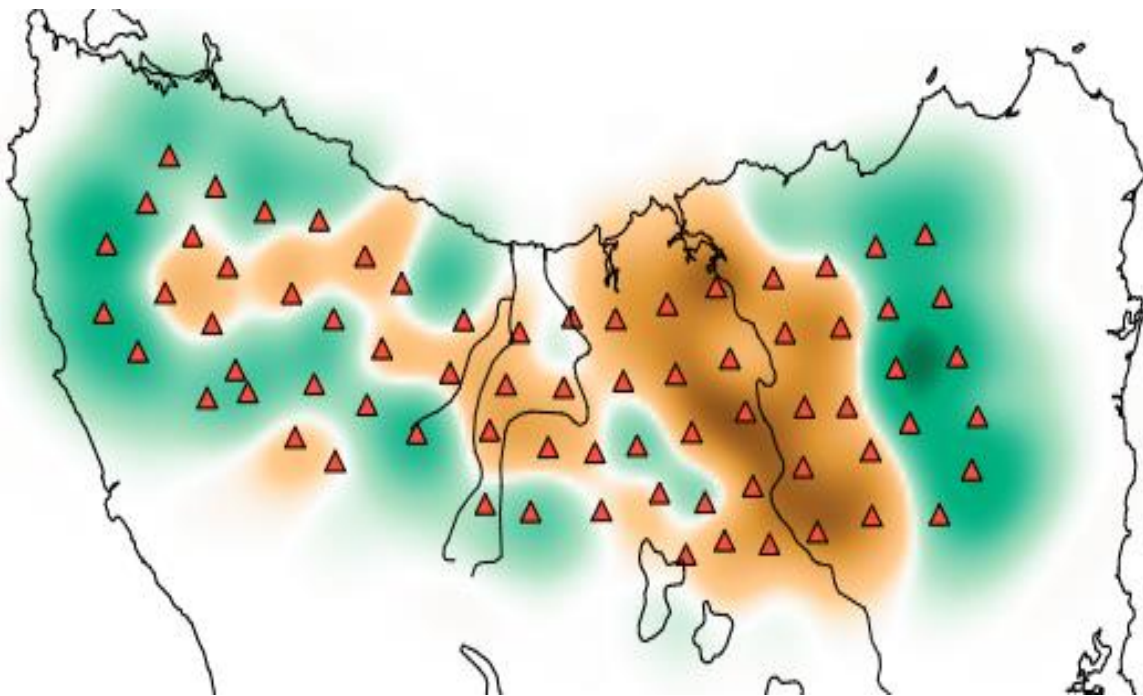


FMTOMO

Overview and Application



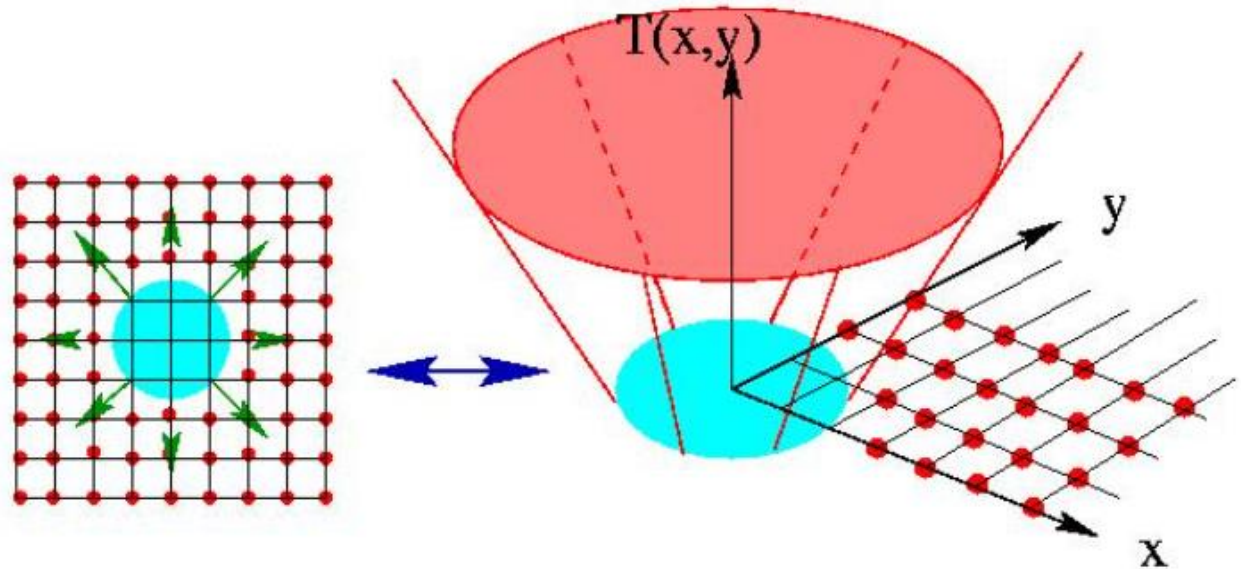
What is FMTOMO?

- Fortran software package to perform 3-D traveltime tomography.
- Uses the fast marching method for the forward step of traveltime prediction.
- Subspace inversion scheme to adjust model parameters in order to satisfy data observations.

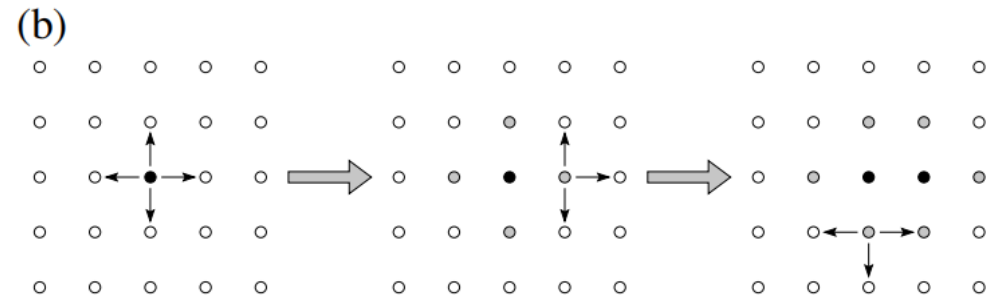
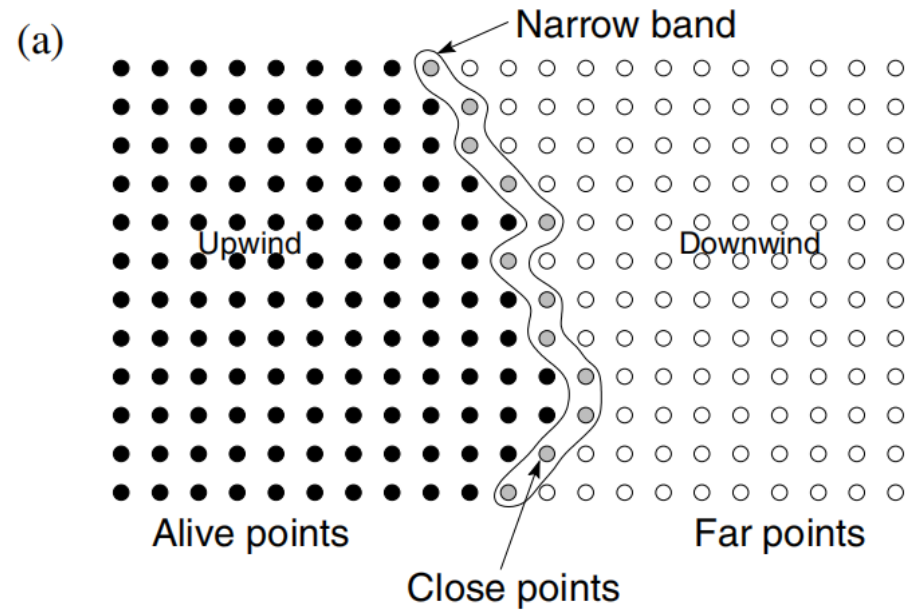
Fast Marching Method (FMM)

$T(x,y)$ gives the time at which the front crosses the point (x,y) .

The function $T(x,y)$ gives a cone-shaped surface. At any height T the surface gives the set of points reached at time T .



Fast Marching Method (FMM)



Rawlinson and Sambridge, 2004

FMM in FMTOMO

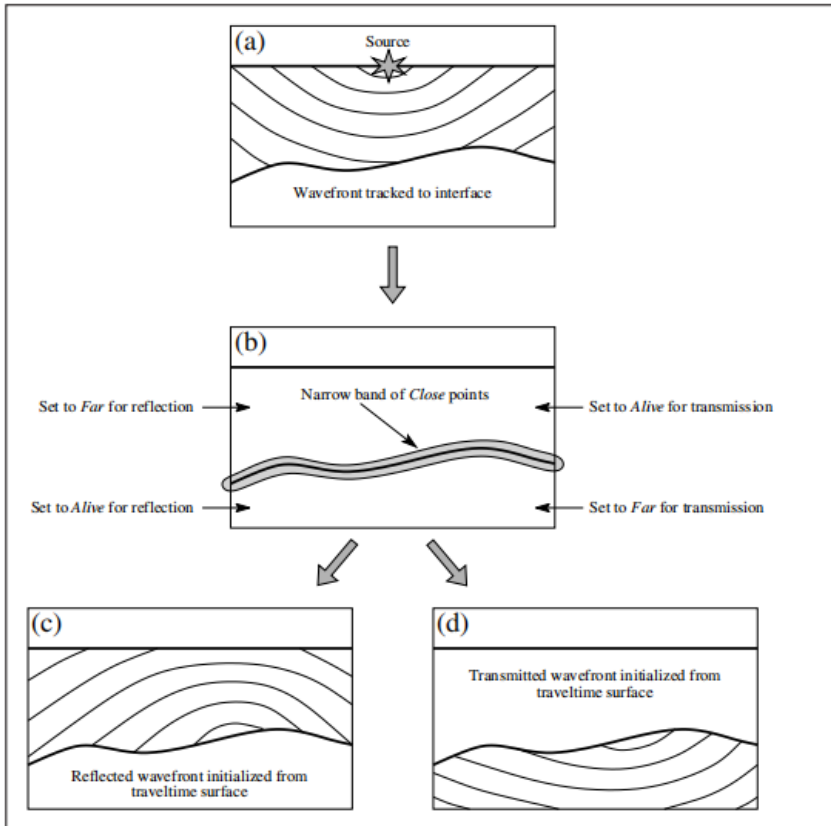
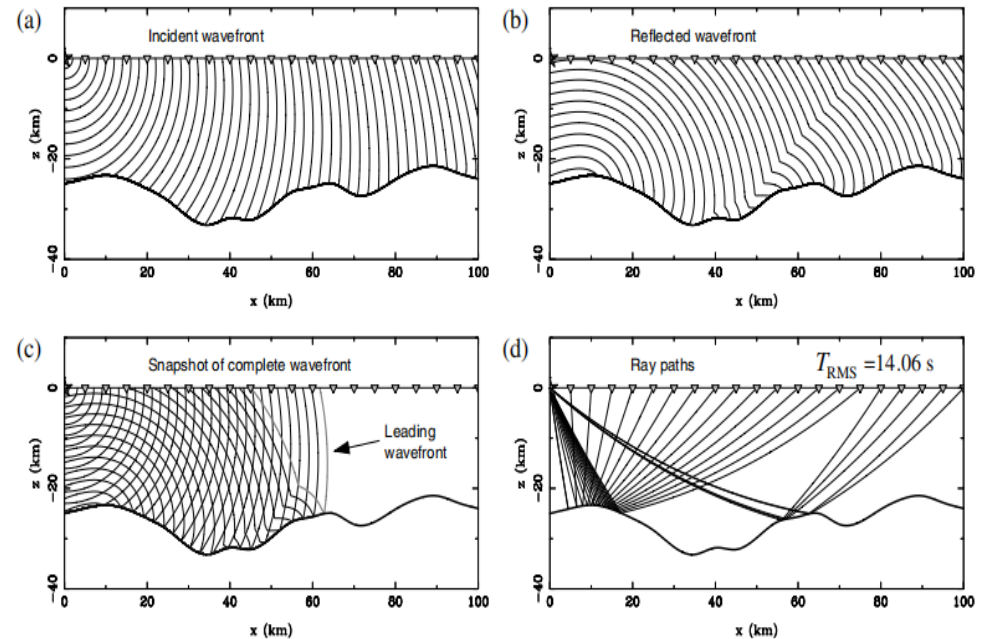


Fig. 4. Principle behind the tracking of reflection and transmission traveltimes. The incident wavefront is tracked to all points on the wavefront, before FMM is reinitialized in the incident (for reflection) or adjacent (for transmission) layer.



Rawlinson and Sambridge, 2005

- Subspace inversion scheme to adjust model parameters in order to satisfy data observations (Rawlinson and Sambridge, 2003: Seismic Traveltime Tomography of the Crust and Lithosphere)

Why FMTOMO?

Solution robustness in the forward step

Multiple phase tracking by FMM

Possibility of introducing interfaces

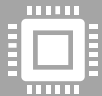
3D spherical co-ordinate

Can be done on your laptop!
(512 Mb - 1 Gb of RAM)

Brief walk through the package



Making grid --- taking in observational data---
adjusting invert3d --- tomo3d (which includes fm3d).



Application to our data, issues faced and solved –
hopefully in my next presentation.

Propagation grid...

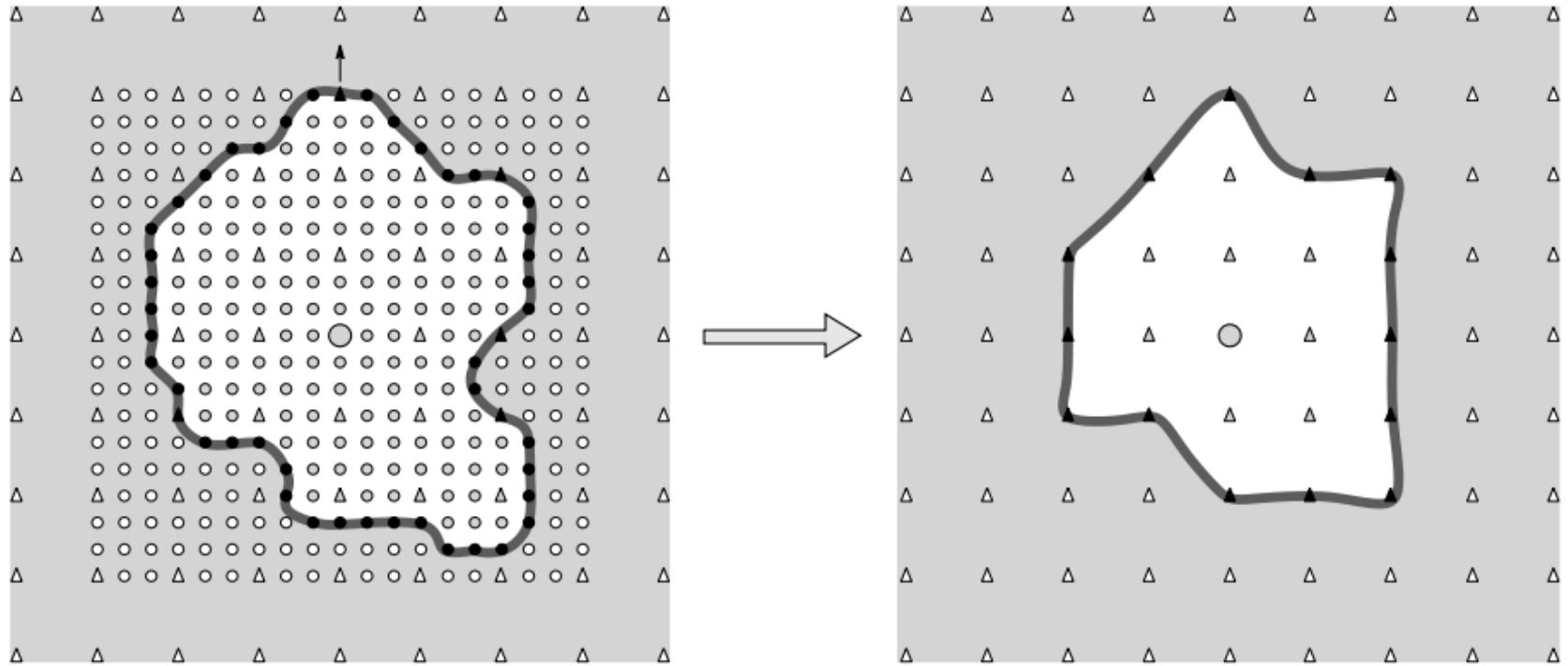


Figure 4: Schematic diagram showing the use of local grid refinement about the source in order to improve traveltimes accuracy. As soon as the wavefront hits the edge of the refined grid, it is mapped back onto the coarser global propagation grid.

Input

- 1-D velocity model (3-D velocity variations from an external file- possible)
- Sources (latitude, longitude, depth, errors)
- Stations/receivers (latitude, longitude, depth)
- Arrival times

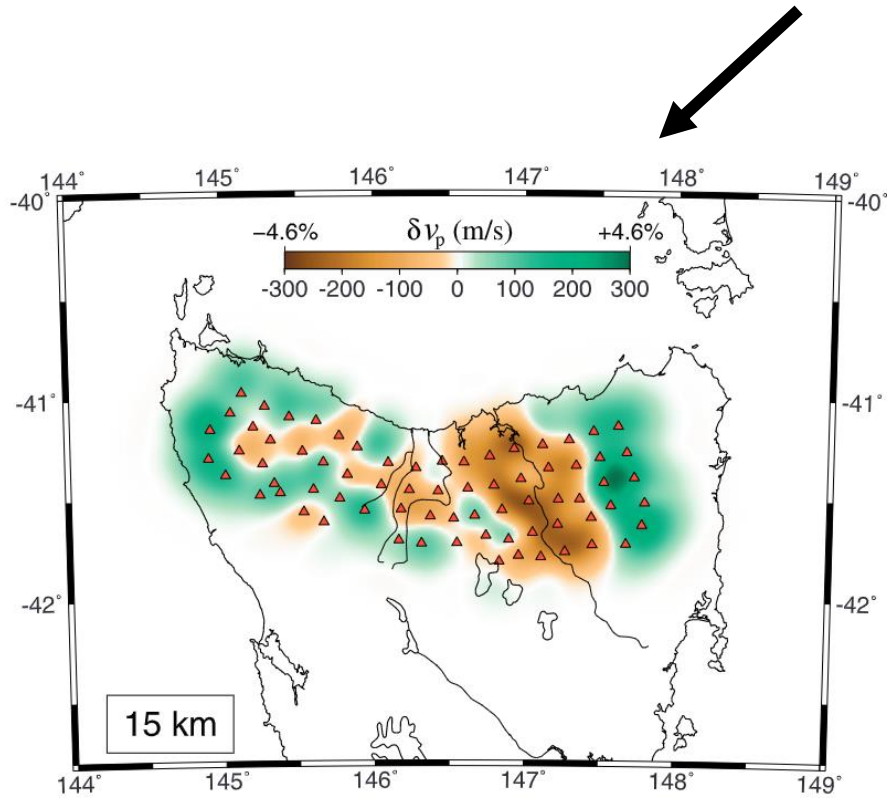


Output

- 3-D grid
- relocated earthquakes
- Velocity model
- Misfit

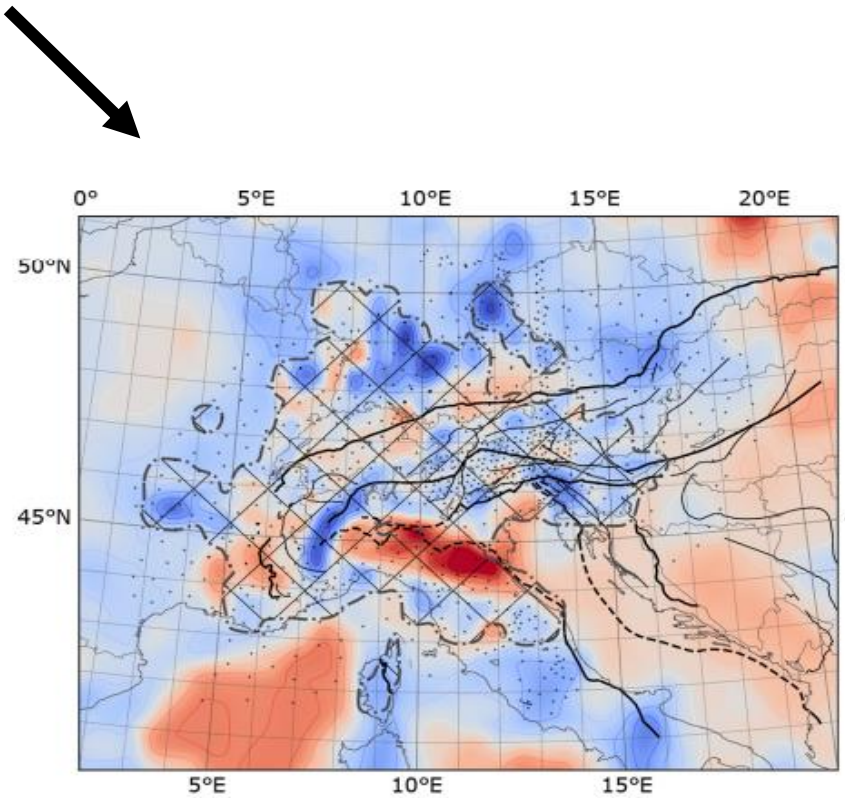
Application-scale

- Simultaneous inversion of local and teleseismic data



(local)

Rawlinson and Urvoy, 2006



(regional)

Paffrath et. al., 2021

Drawbacks?



Slow



Not easy to use (documentation exists, but some more details needed)



Not very clear error messages.



Plotting routines included. But needs to be upgraded with the current GMT version.

Thank You !