Prevailing-frequency approximation of the coupling ray theory for S waves along the SH and SV reference rays in a transversely isotropic medium

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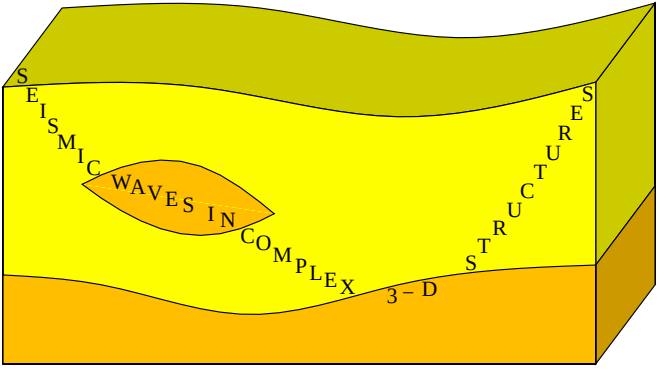

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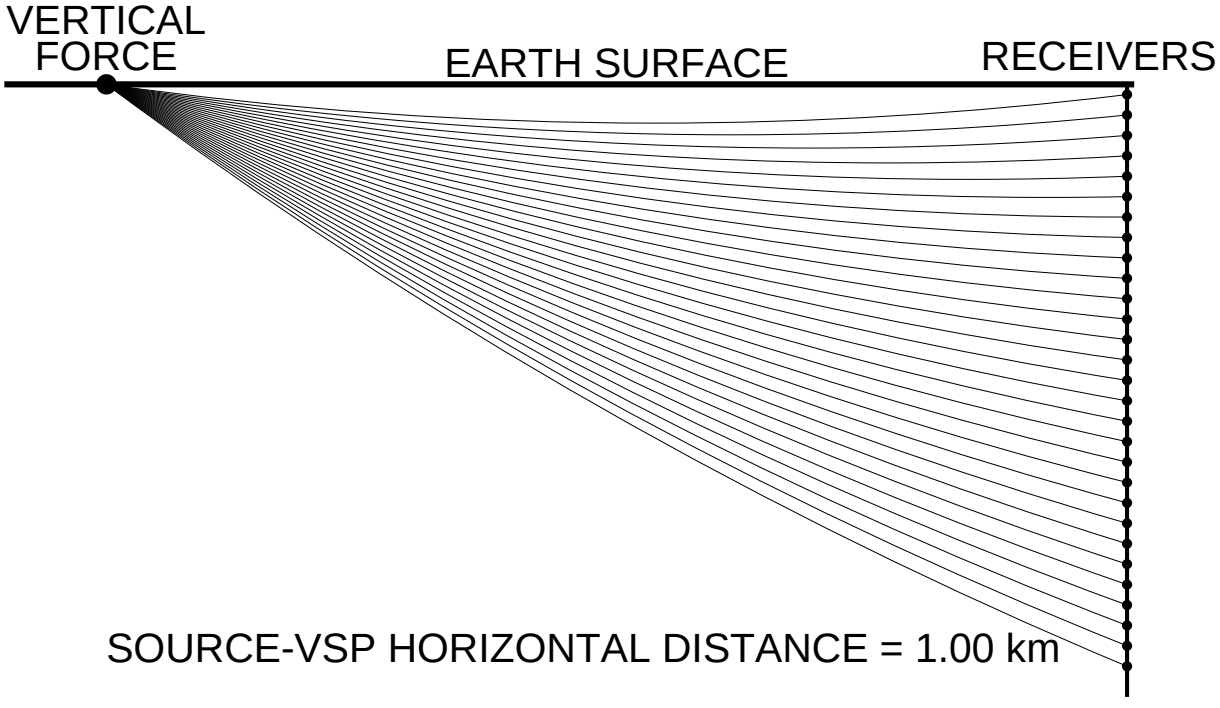
In an a priori known transversely isotropic medium, we may trace the SH and SV rays.

We apply the prevailing-frequency approximation of the coupling ray theory (Klimeš & Bulant, 2012) to the SH and SV reference rays. We obtain two S-wave arrivals along each SH ray and have to select the right one of them. Analogously, we obtain two S-wave arrivals along each SV ray and have to select the right one of them. We select the right arrivals according to their polarization and travel time (Klimeš & Bulant, 2014).

Source-receiver configuration in velocity models QI2 and QI4

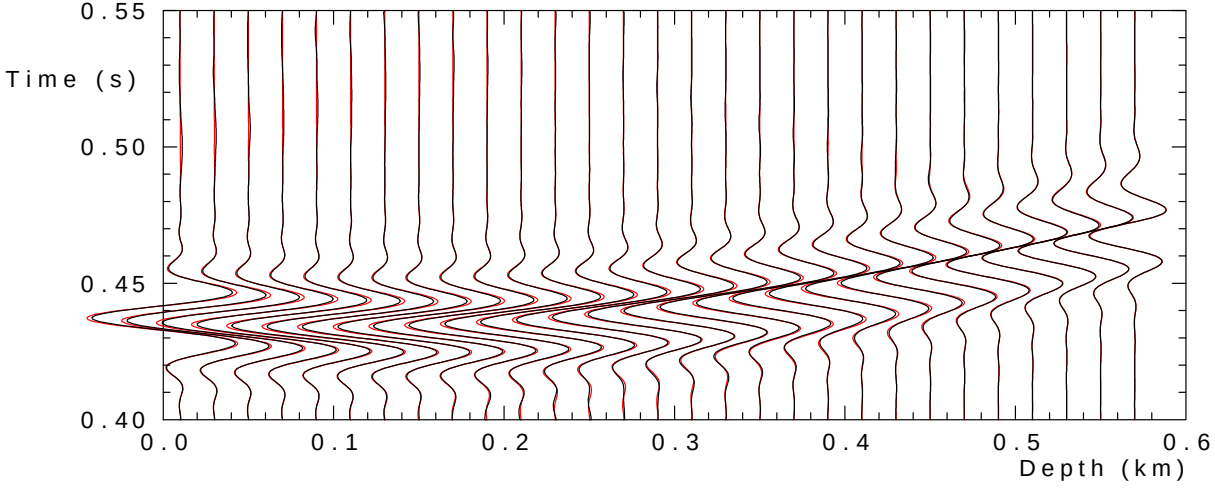


Synthetic seismograms in velocity models QI2 and QI4

The **red** seismograms are calculated using the prevailing-frequency approximation of the coupling ray theory
(a) along the anisotropic common S-wave rays with the quadratic perturbation expansions of travel times, and
(b) along the SH and SV reference rays with the linear perturbation expansions of travel times.

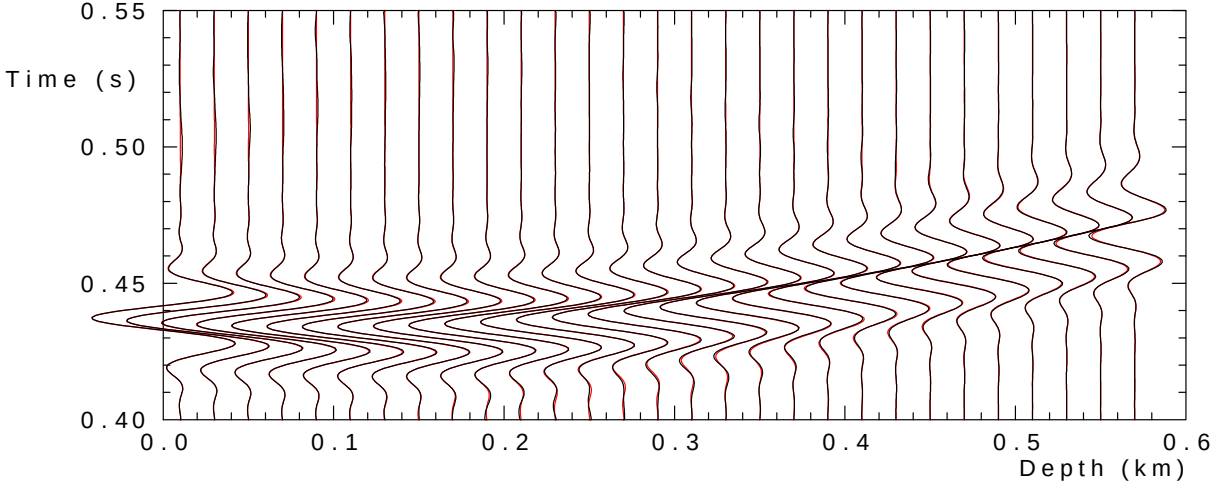
They are overlaid by the **black** seismograms calculated using the Fourier pseudospectral method by Pšenčík, Farra & Tessmer (2012) which is considered here as a nearly exact reference.

Model QI2, vertical component



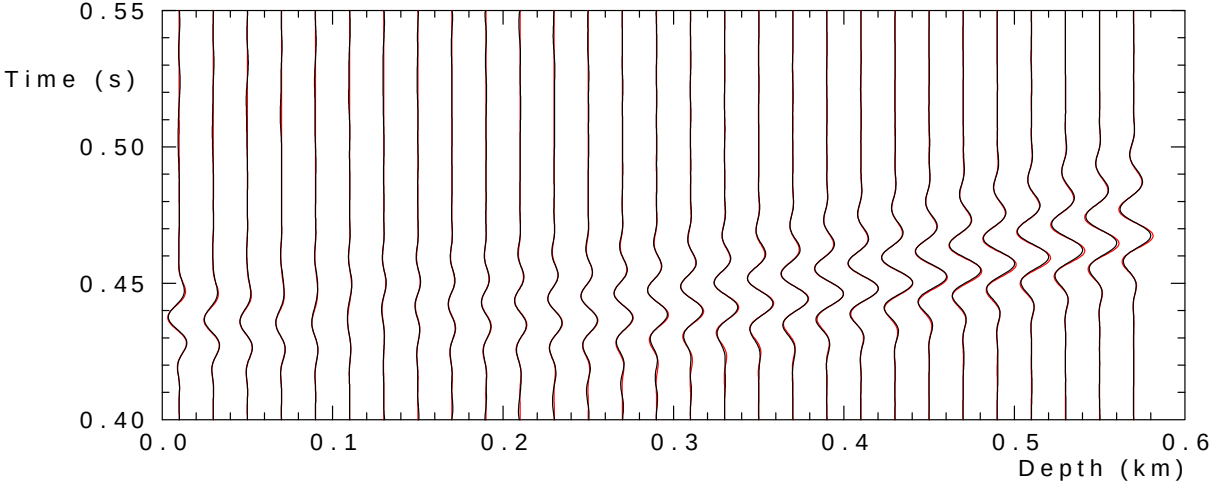
Anisotropic common S-wave reference rays.

Model QI2, vertical component



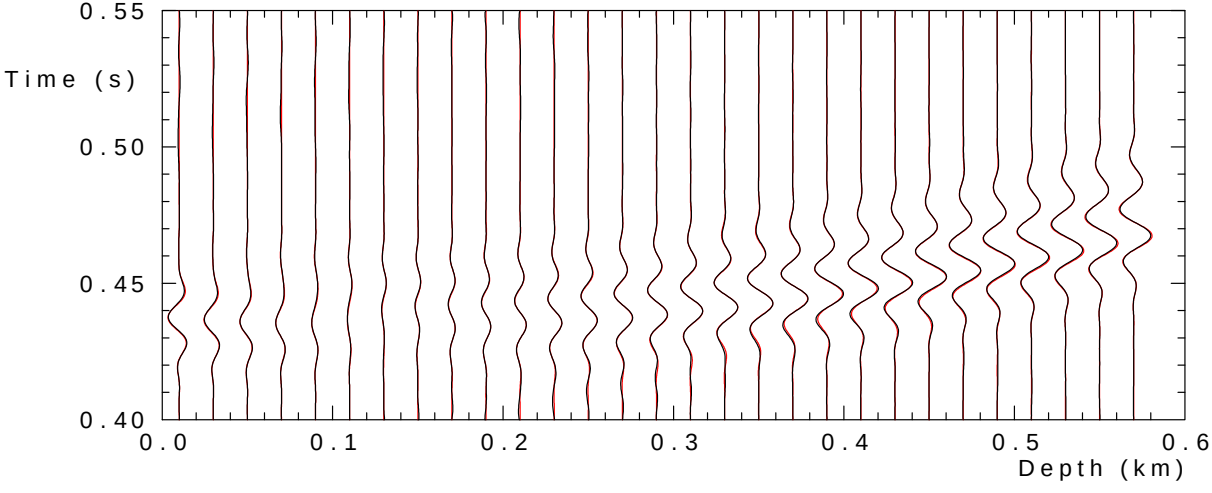
SH and SV reference rays.

Model QI2, radial component



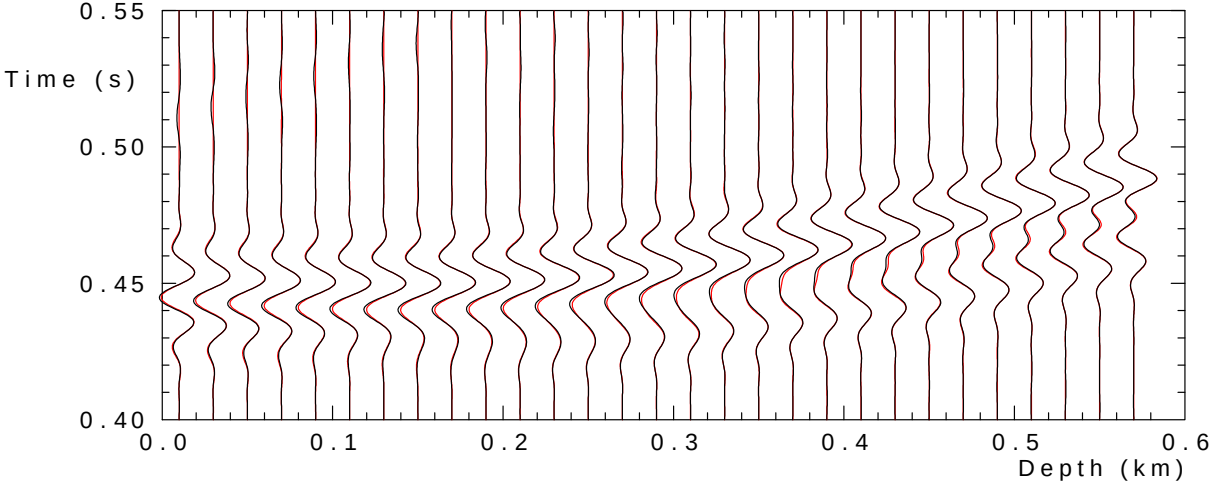
Anisotropic common S-wave reference rays.

Model QI2, radial component



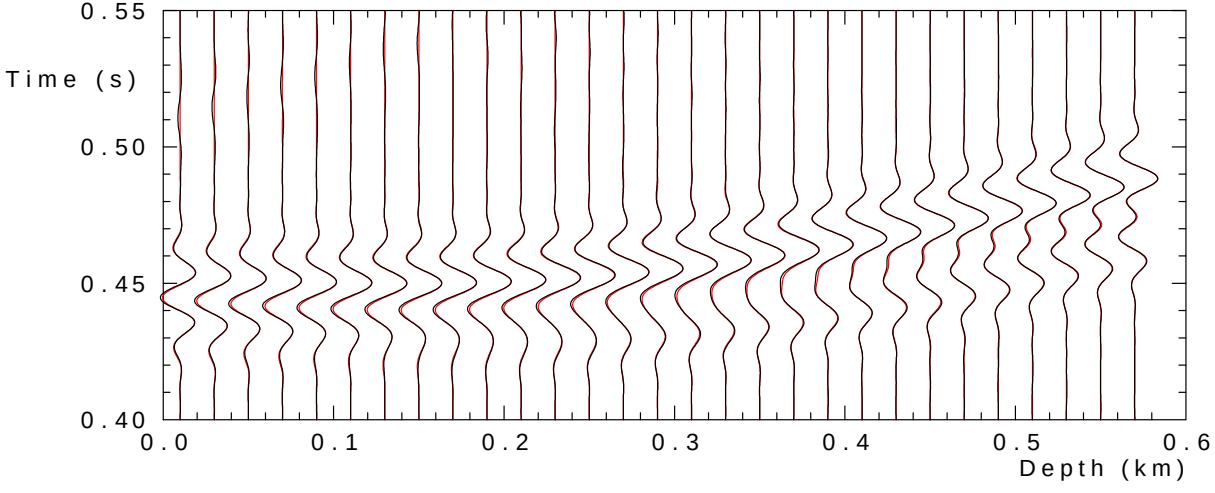
SH and SV reference rays.

Model QI2, transverse component



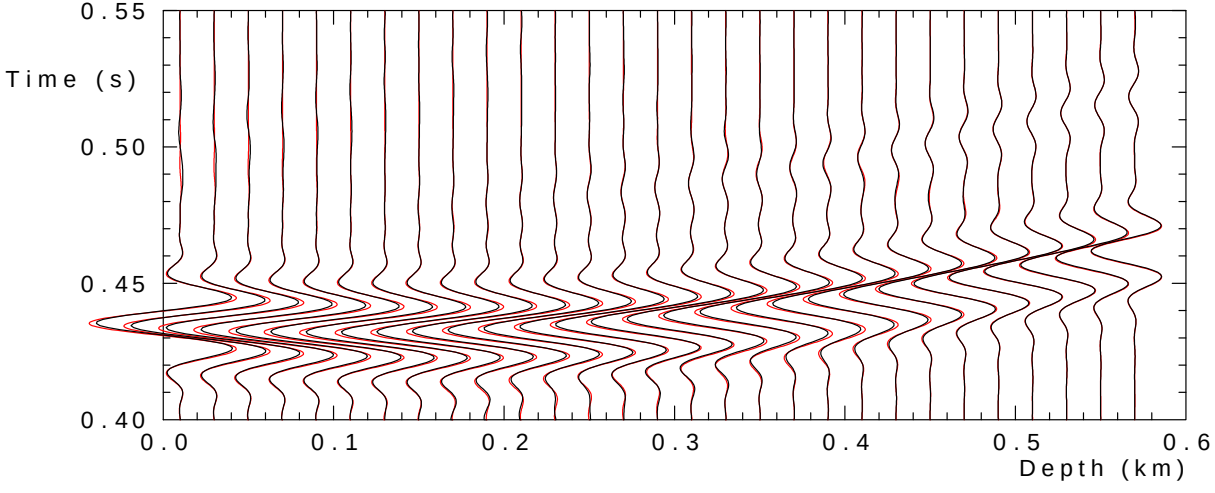
Anisotropic common S-wave reference rays.

Model QI2, transverse component



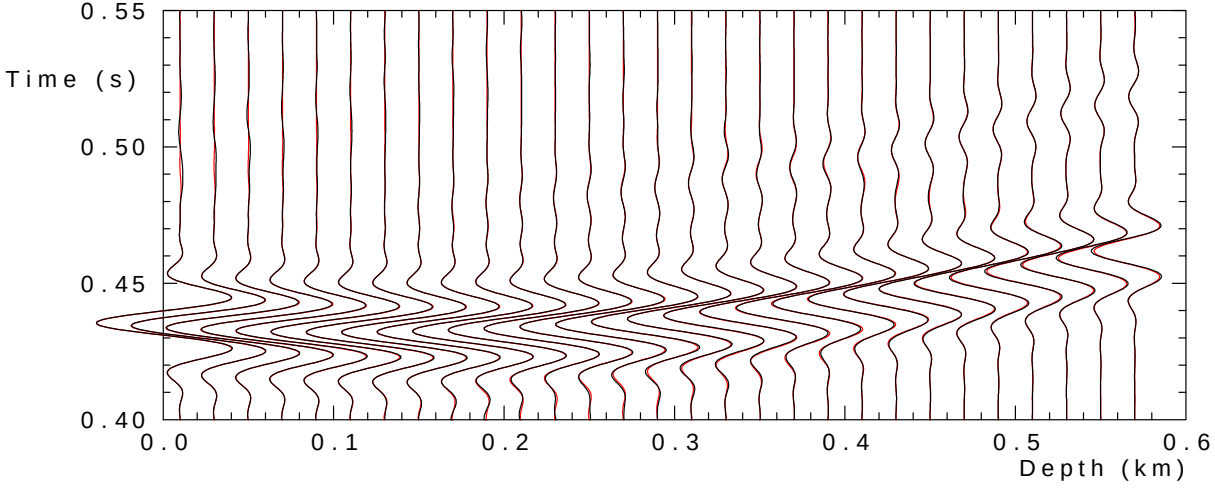
SH and SV reference rays.

Model QI4, vertical component



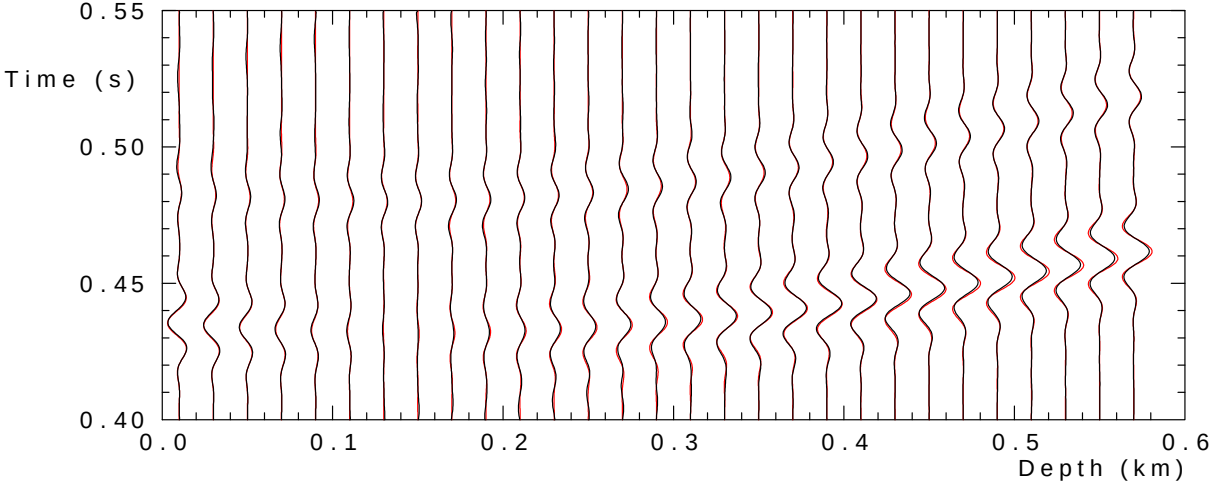
Anisotropic common S-wave reference rays.

Model QI4, vertical component



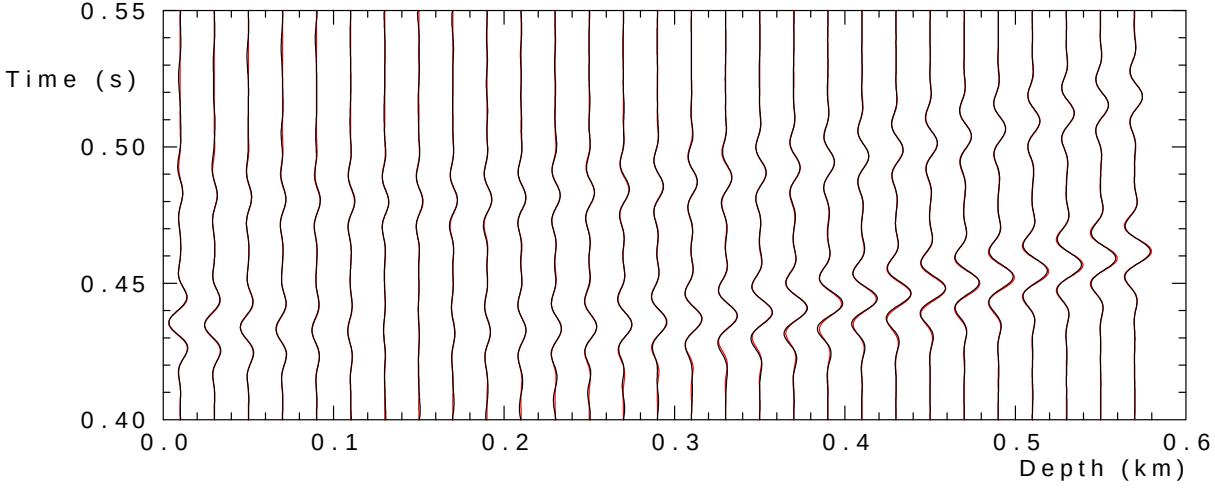
SH and SV reference rays.

Model QI4, radial component



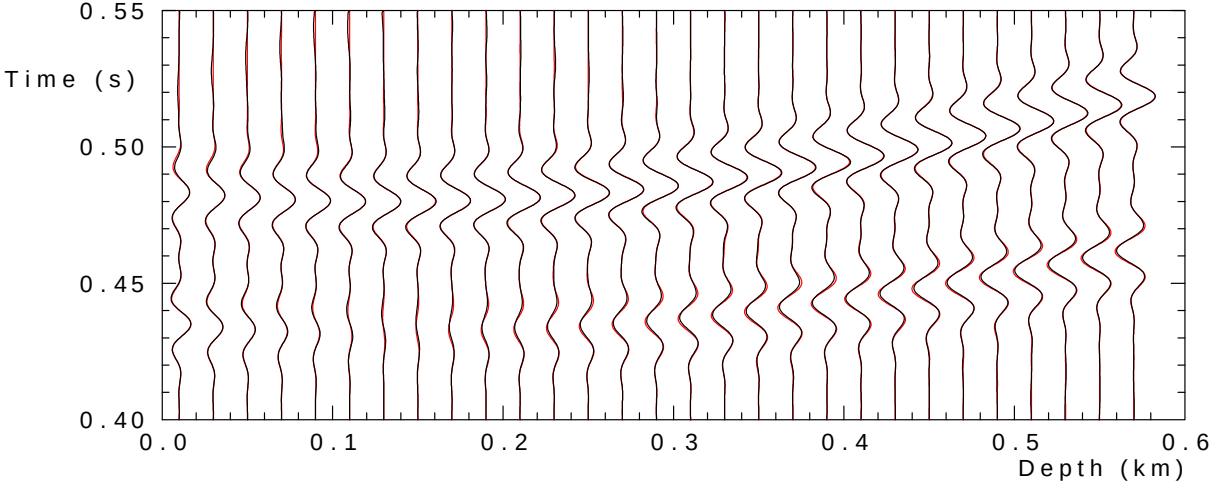
Anisotropic common S-wave reference rays.

Model QI4, radial component



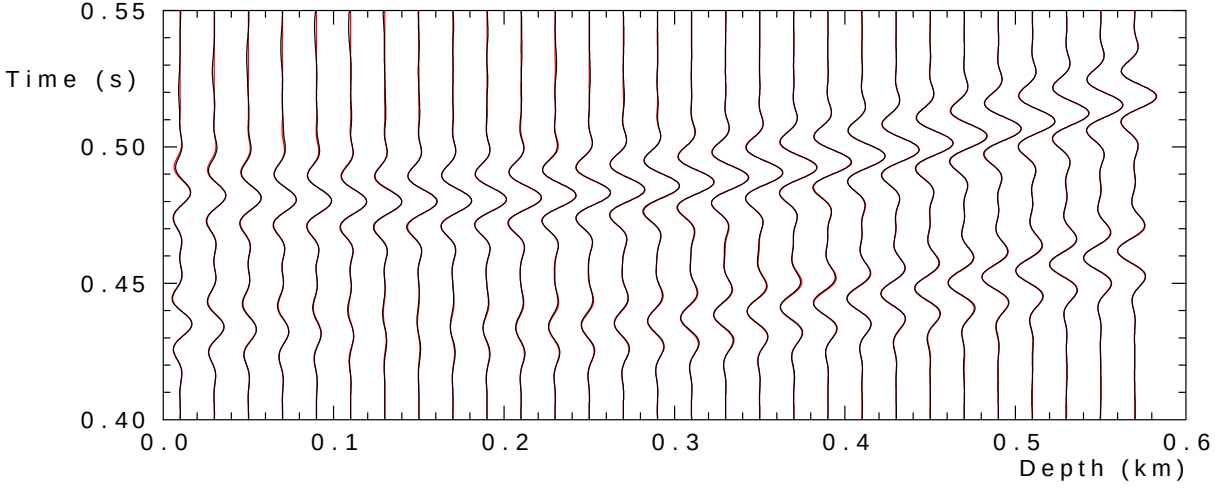
SH and SV reference rays.

Model QI4, transverse component



Anisotropic common S-wave reference rays.

Model QI4, transverse component



SH and SV reference rays.

Conclusions

In an a priori known transversely isotropic medium, the prevailing-frequency approximation of the coupling ray theory along the SH and SV reference rays is more accurate than along the anisotropic common reference rays.

If a velocity model is close to transversely isotropic, we may approximate it by a transversely isotropic velocity model and trace the SH and SV reference rays in the transversely isotropic velocity model, and apply the prevailing-frequency approximation of the coupling ray theory along the SH and SV reference rays to the original velocity model.

For further testing and applications, we would need to develop the algorithm of SH and SV ray tracing in heterogeneous transversely isotropic velocity models with intersection singularities.

As we shall see in the next contributions, there are many anisotropic velocity models in which the anisotropic-ray-theory S-wave rays are worse reference rays than the anisotropic common S-wave rays.

References

Klimeš, L. & Bulant, P. (2012): Single-frequency approximation of the coupling ray theory. In: *Seismic Waves in Complex 3-D Structures, Report 22*, pp. 143–167, Dep. Geophys., Charles Univ., Prague, online at "http://sw3d.cz".

Klimeš, L. & Bulant, P. (2014): Prevailing-frequency approximation of the coupling ray theory for S waves along the SH and SV reference rays in a transversely isotropic medium. *Seismic Waves in Complex 3-D Structures*, **24**, 165–177, online at "http://sw3d.cz".

Pšenčík, I., Farra, V. & Tessmer, E. (2012): Comparison of the FORT approximation of the coupling ray theory with the Fourier pseudospectral method. *Stud. geophys. geod.*, **56**, 35–64.

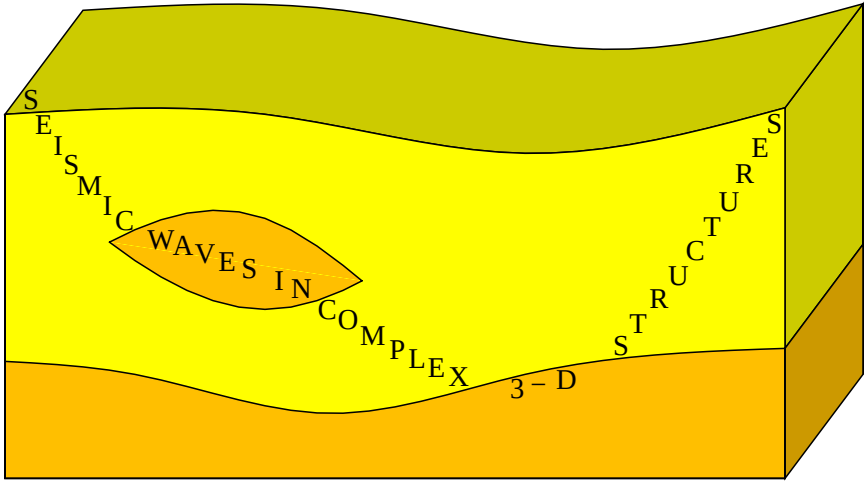
Acknowledgements

The research has been supported:

by the Grant Agency of the Czech Republic under contract P210/10/0736,

by the Ministry of Education of the Czech Republic within research projects MSM0021620860 and CzechGeo/EPOS LM2010008,

and by the consortium "Seismic Waves in Complex 3-D Structures"



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