Use of wavefront attributes for tomographic model building with active and passive seismic data

D. Gajewski, A. Bauer, B. Schwarz and J. Walda

Institute of Geophysics, University of Hamburg
Wave Inversion Technology (WIT)

Motivation

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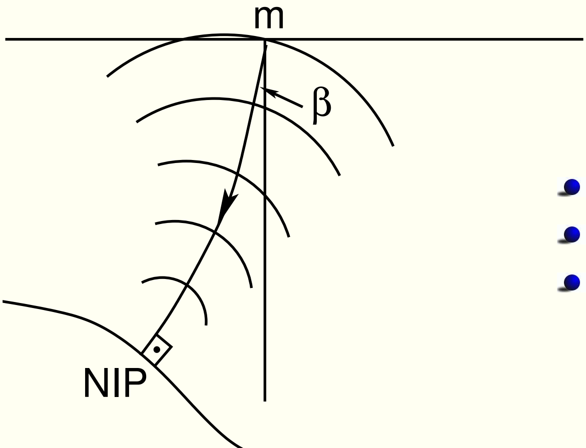
- Tomography based on ZO wavefront attributes (Duveneck, 2004)

Wavefront Tomography

For a consistent velocity model NIP-waves focus at the NIP for zero traveltime when propagated back to the subsurface (Duveneck, 2004).



- picking in stacked data
- ray tracing
- model update

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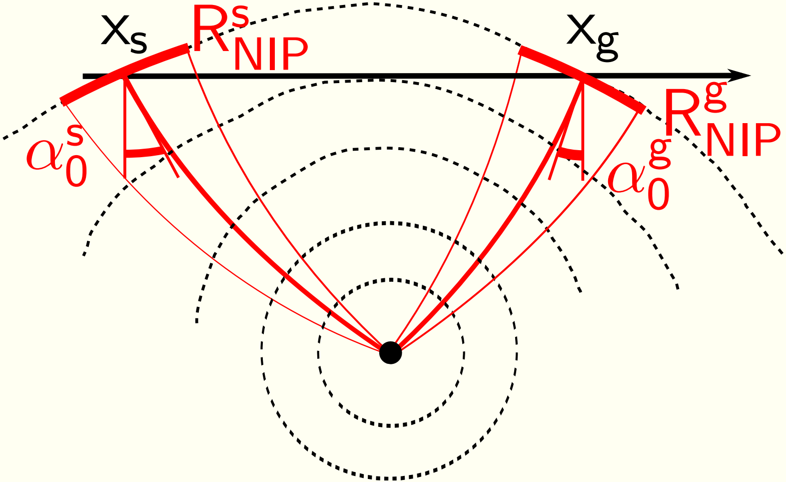
Decomposition Principle



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→ Use diffracted and passive events for velocity inversion

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- Wavefront tomography
- Simple synthetic data examples
  - Diffraction
  - Passive seismics

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- Conclusions and outlook

Wavefront attribute estimation

- Active seismics: (nonhyperbolic) ZO CRS stack

$$t = t_s(t_0, \alpha, R_{NIP}, R_N) + t_g(t_0, \alpha, R_{NIP}, R_N)$$

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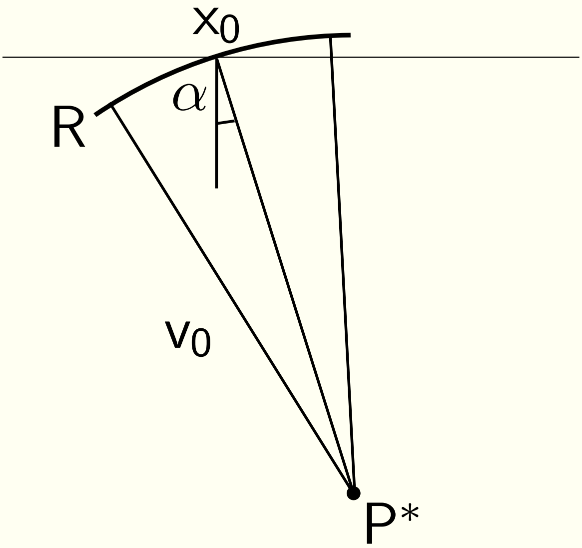
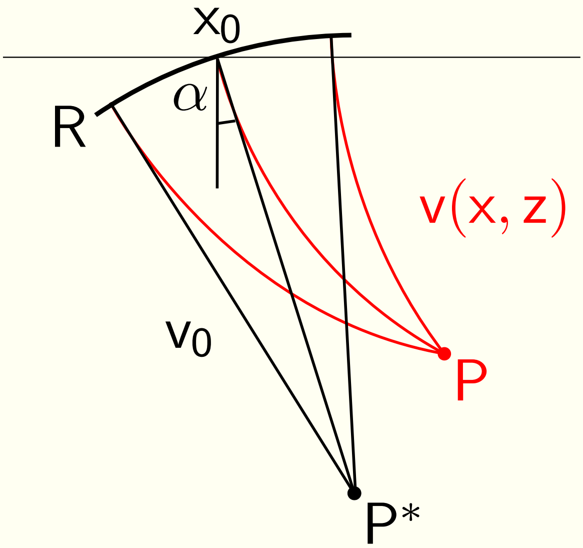
- Passive seismics: One additional attribute (t_s)

$$t = t_s + t_g(t_0, \alpha, R)$$

Wavefront tomography: Image space



Wavefront tomography: Model space



Wavefront tomography: Inverse problem

- Input: n picked data points $(x_0, t_0, \alpha, R)_i$

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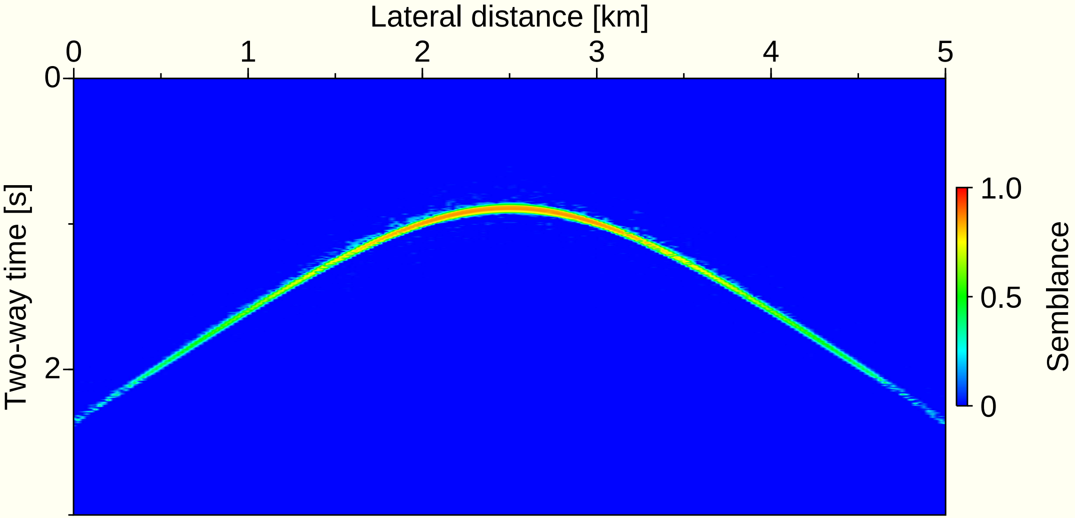
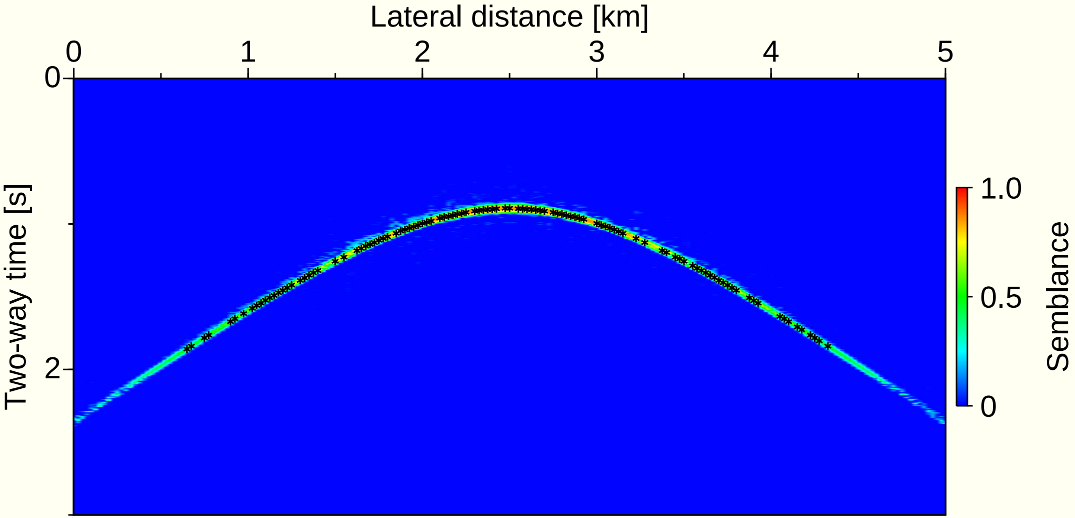
- Output: smooth velocity model $v(x,z)$

Diffraction example: Input semblance



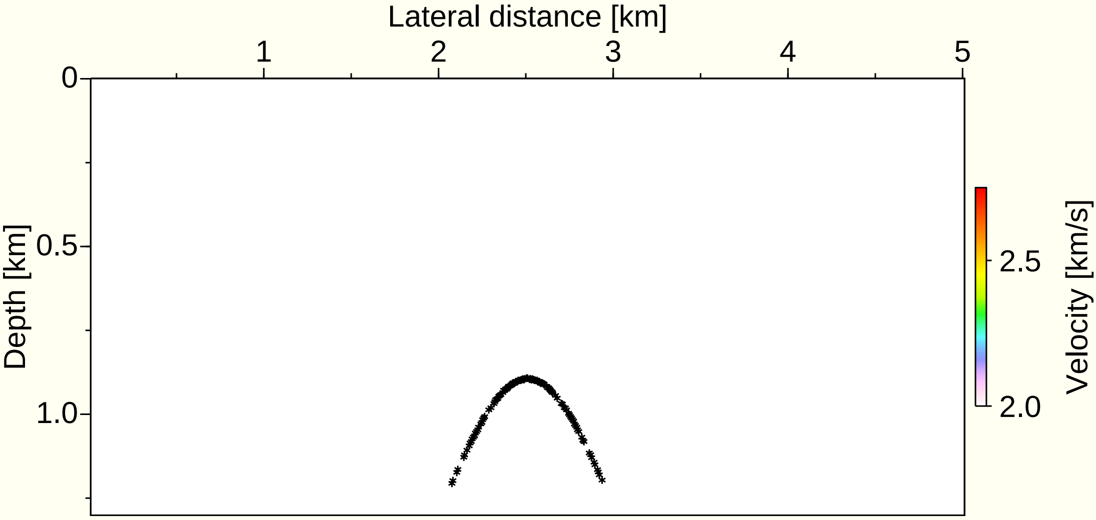
Input semblance

Diffraction example: Picked data points



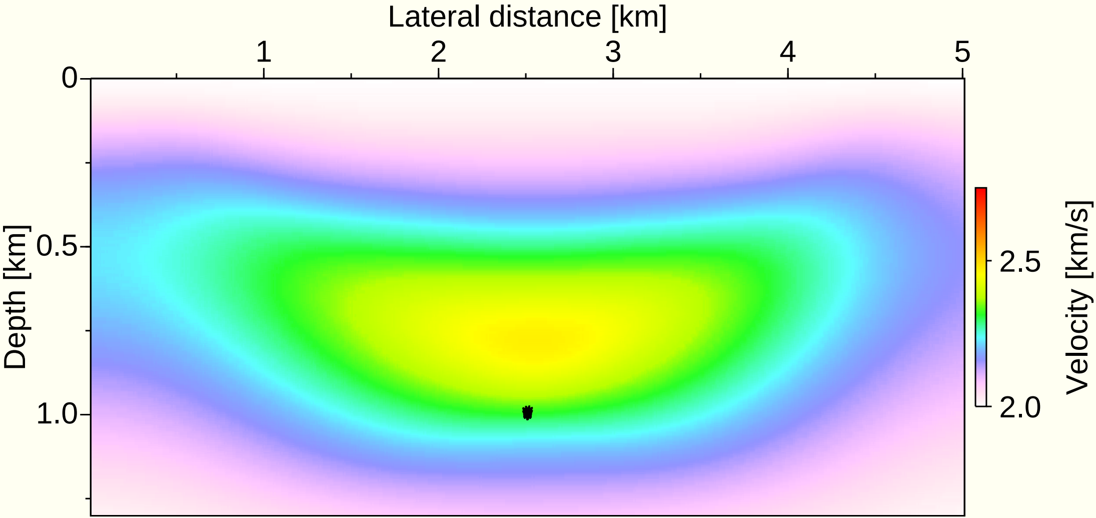
Picked data points

Diffraction example: Initial model



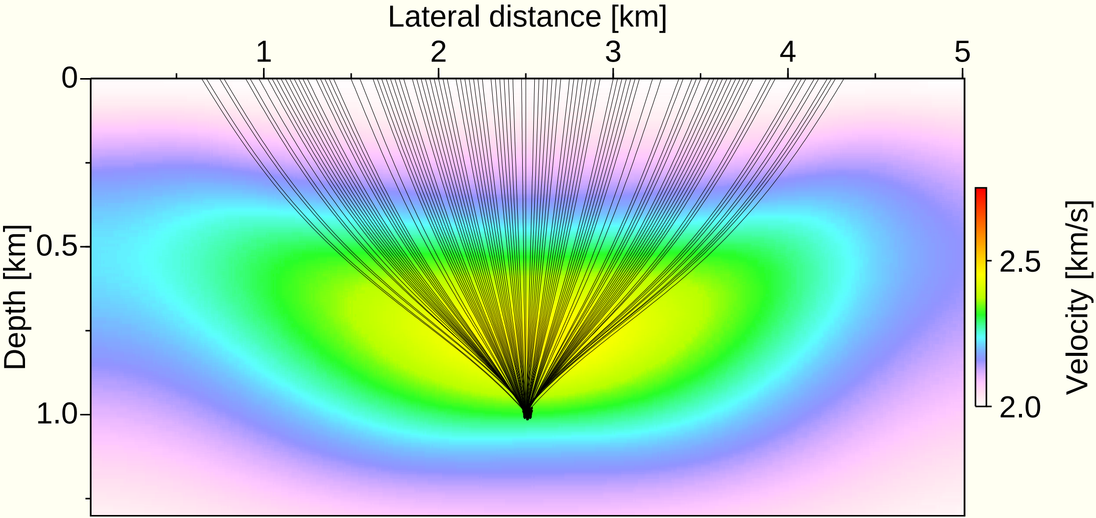
Initial model

Diffraction example: Inverted model



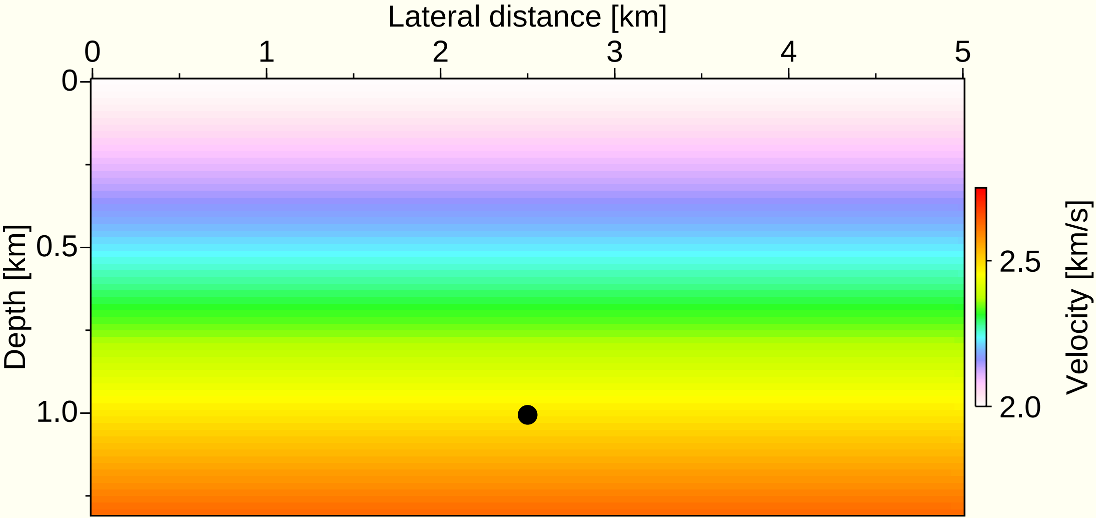
Inverted model

Diffraction example: Inverted model



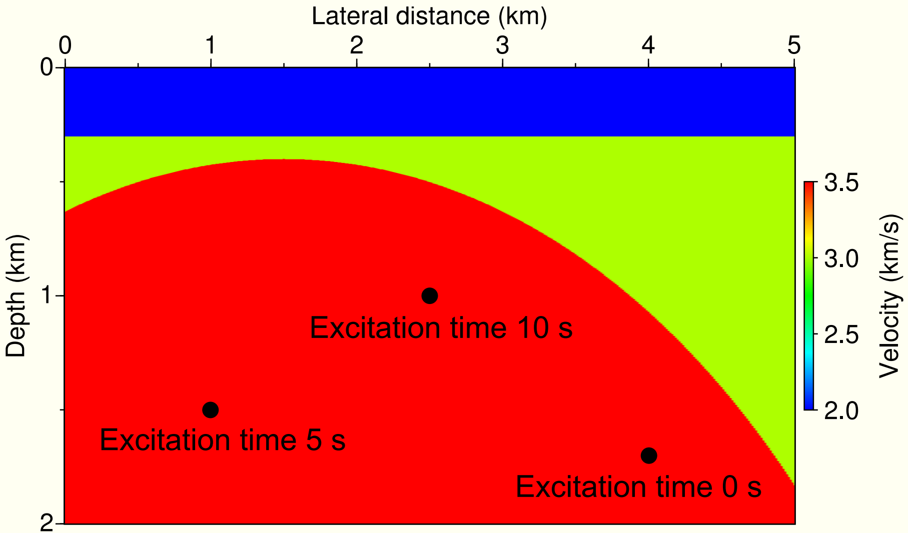
Inverted model

Diffraction example: Correct model



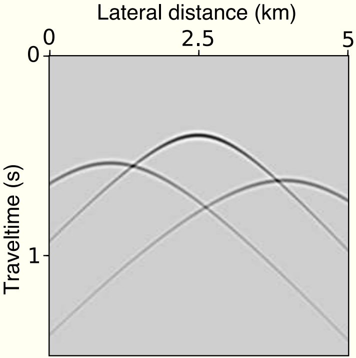
Correct model

Passive data example

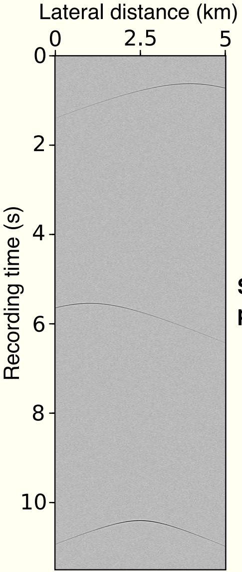


Model

Passive data example

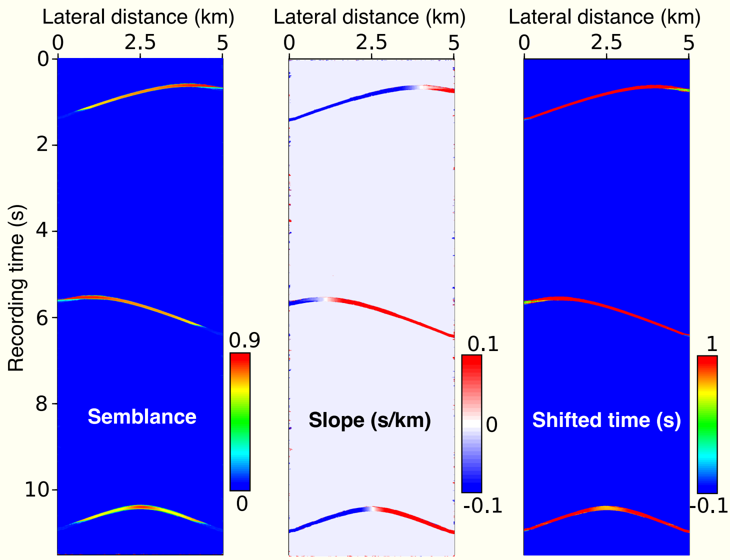


Modeled data

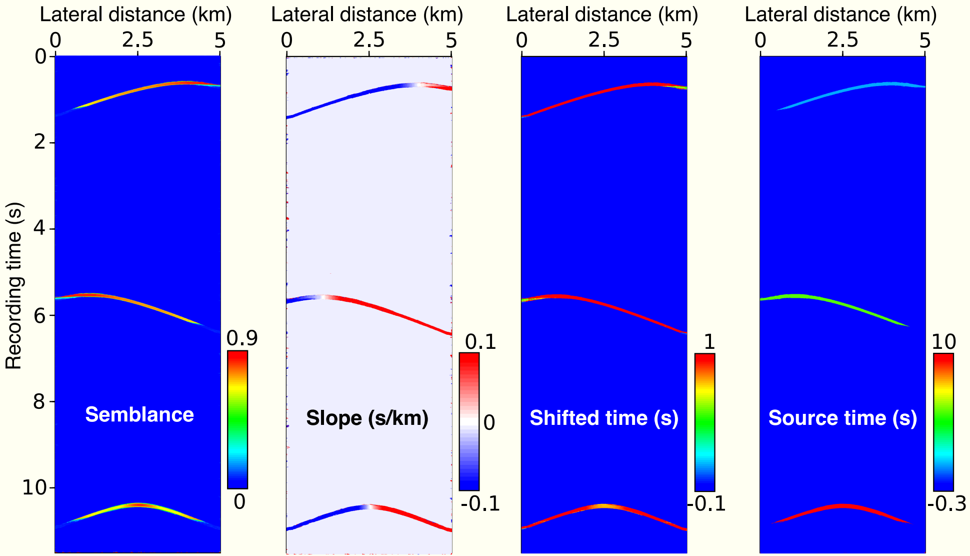


Simulated passive data

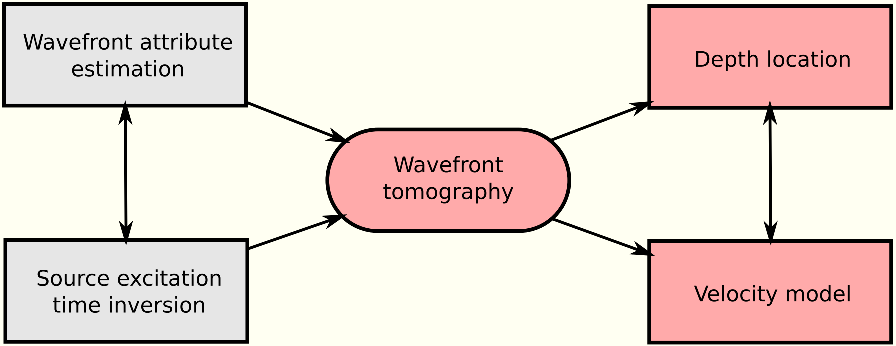
Passive attribute panels



Passive attribute panels



Joint location and velocity inversion



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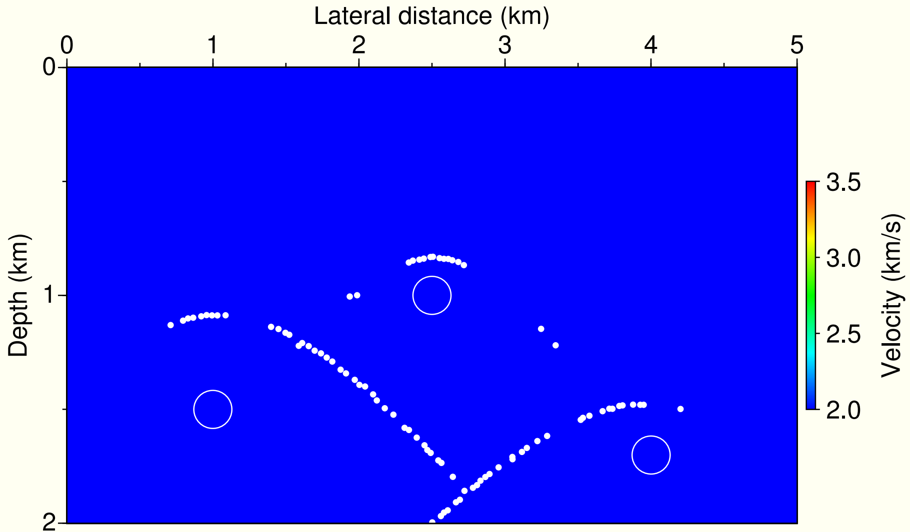
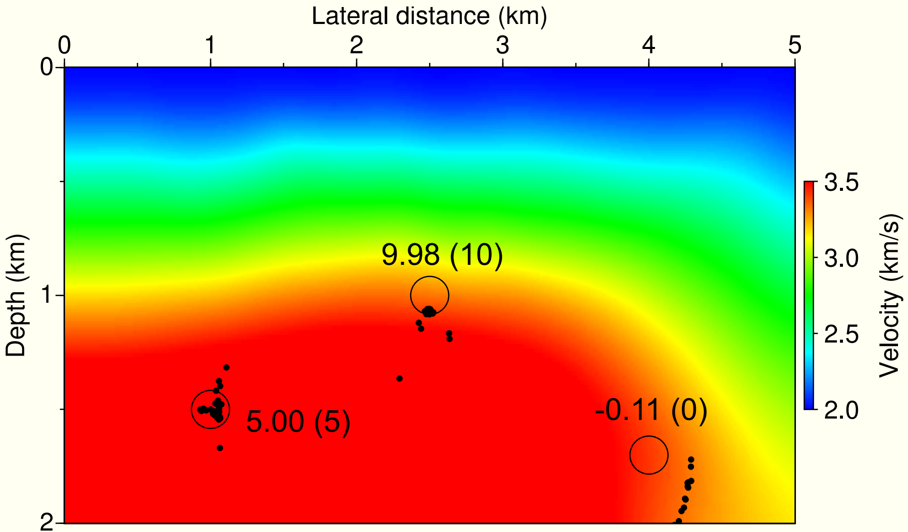


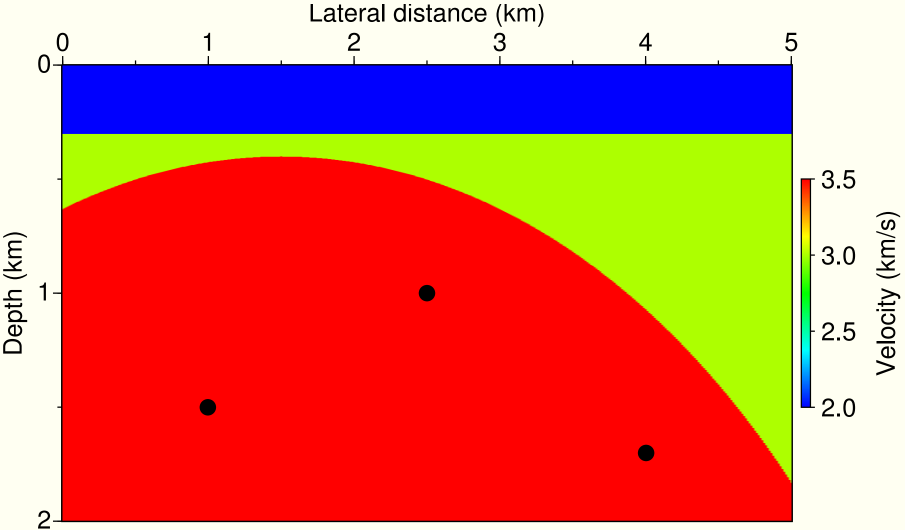
Starting model

Joint location and velocity inversion



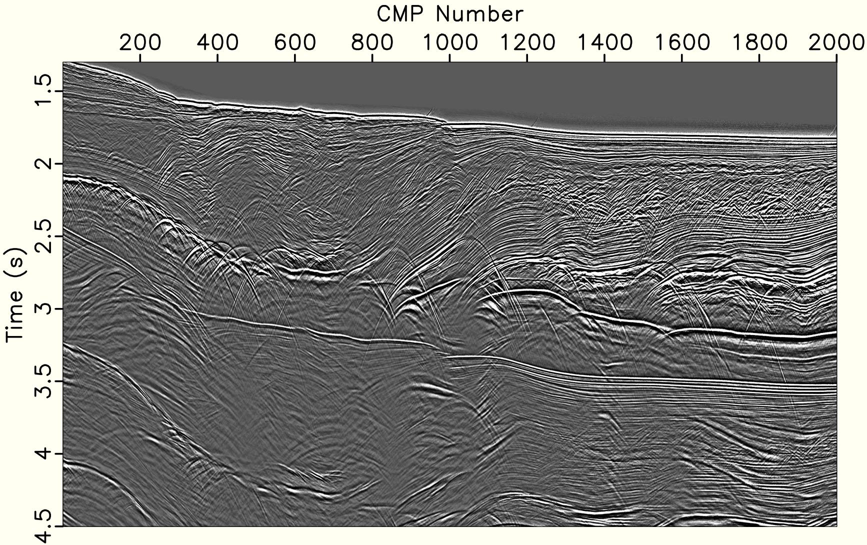
Wavefront tomography

Joint location and velocity inversion

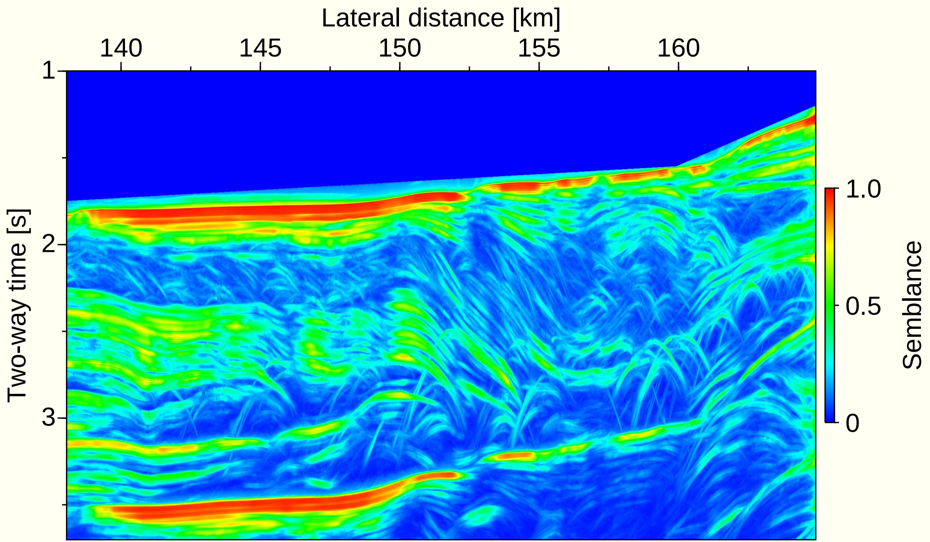


True model

Field data: Stack

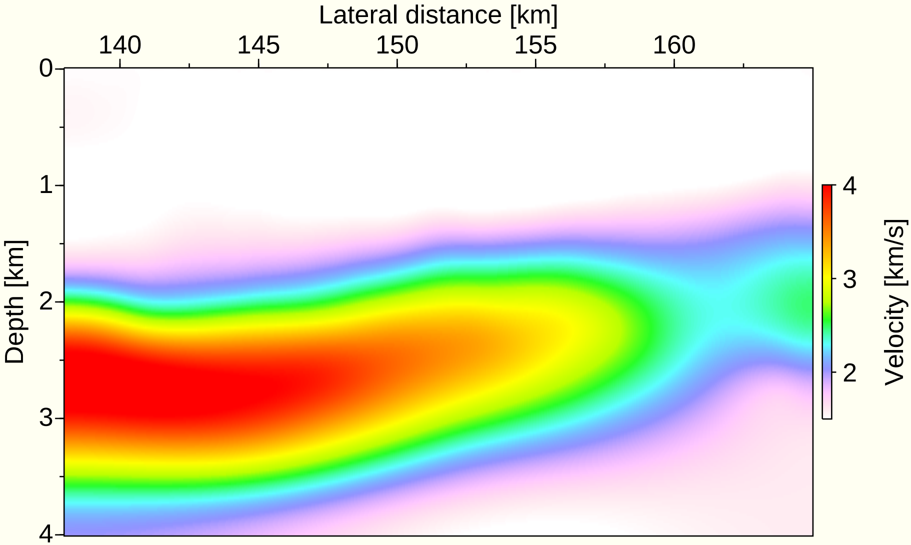


Field data: Input semblance



Input semblance

Field data: Reflection-based inversion



Reflection-based inverted model

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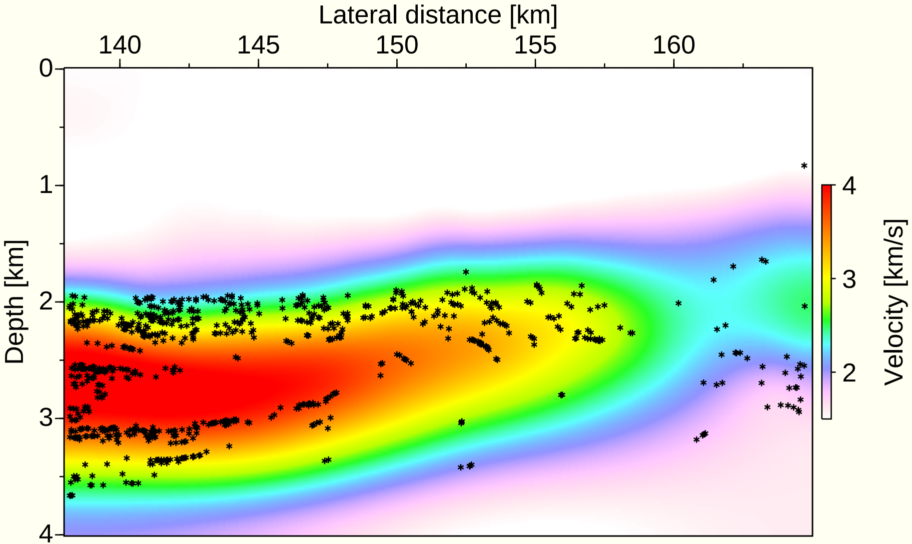

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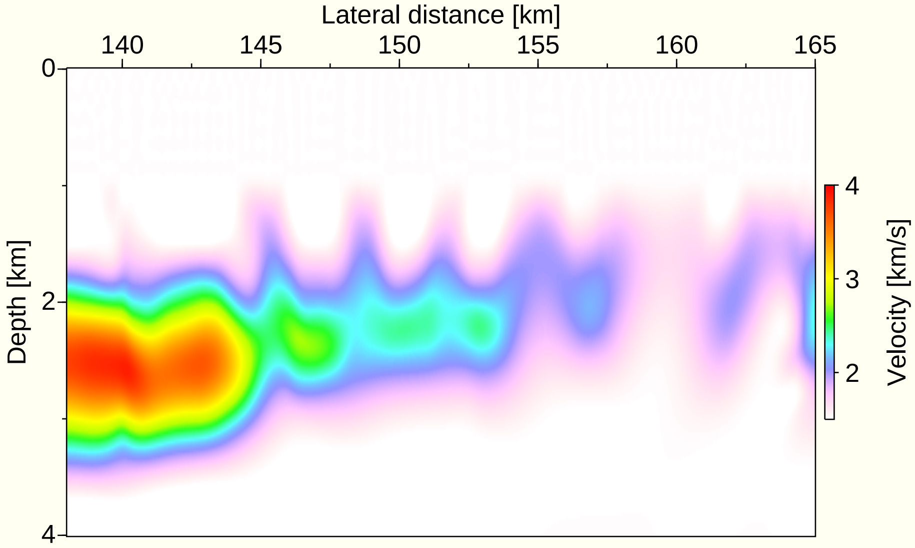

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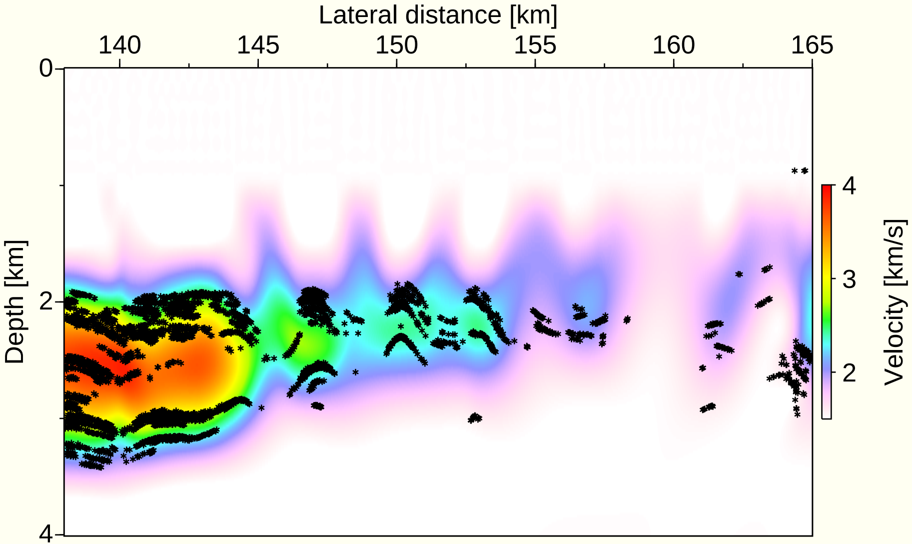

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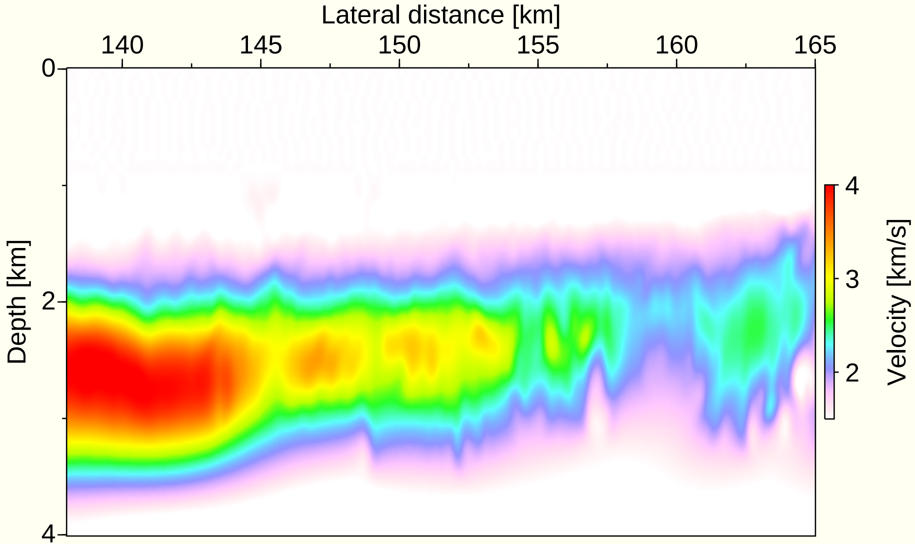
Field data: Joint inversion



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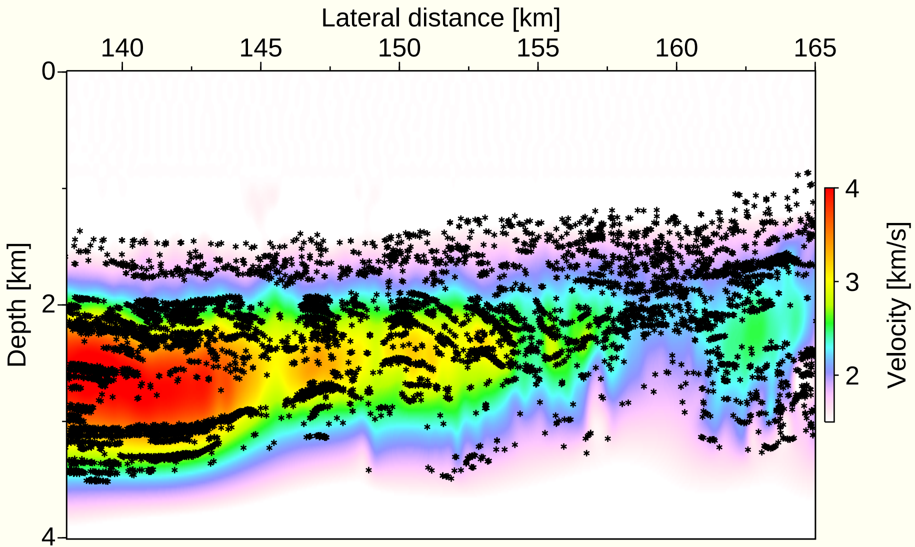

Inverted model

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  - Global optimization

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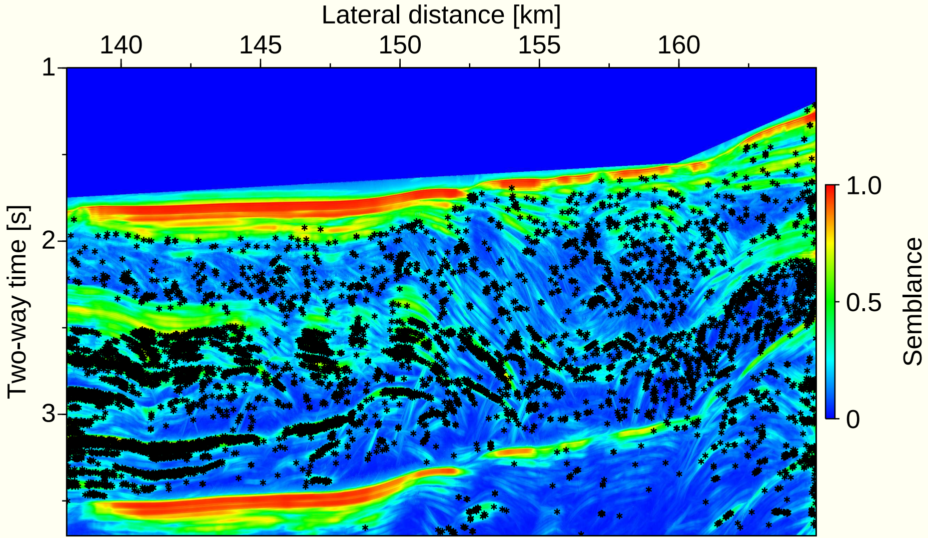
Acknowledgments

- Applied Seismics Group Hamburg
- Sponsors of the WIT consortium
- TGS
- Seismic Un*x
- NORSAR

Field data: Picked data points



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