True-amplitude CRS-based Kirchhoff time migration for AVO analysis

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Overview

Motivation
Principle
Effect of migration aperture on amplitudes

Common-Reflection-Surface stack

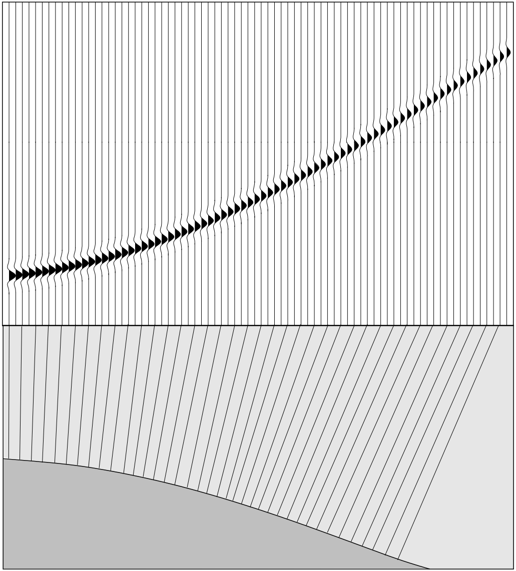
Adapted workflow
Extraction of CRS attributes
Velocity model determination
Determination of migration attributes

Synthetic data example

Conclusions

Acknowledgments

Kirchhoff migration



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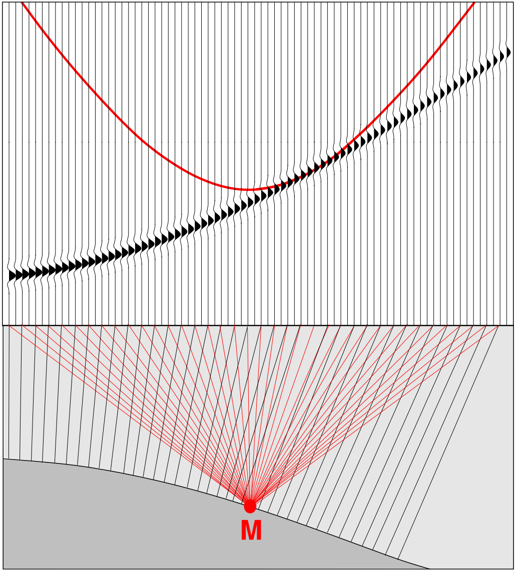
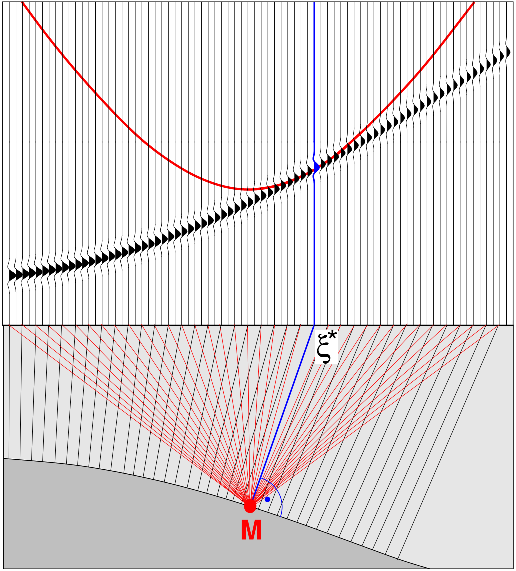
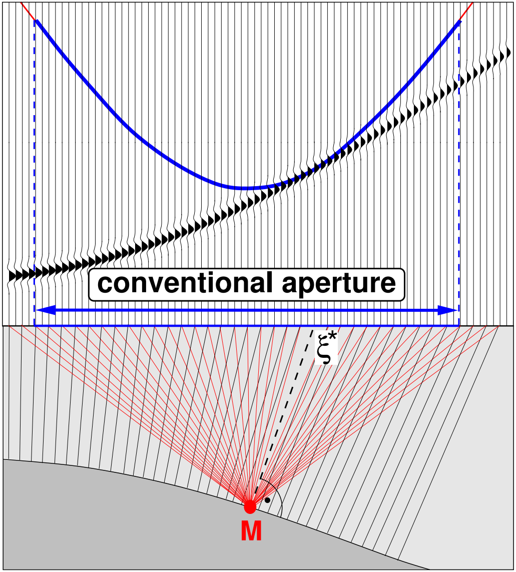


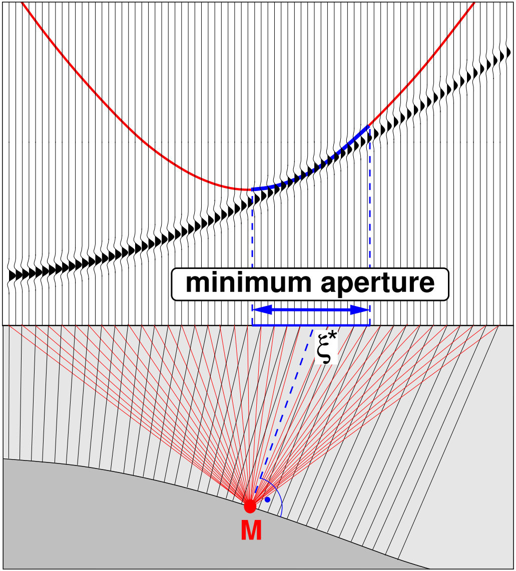
Kirchhoff migration: stationary point



Kirchhoff migration: conventional aperture



Kirchhoff migration: minimum aperture



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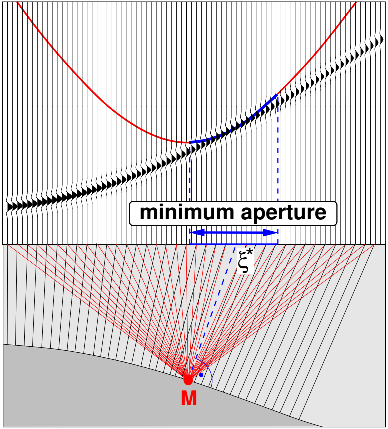

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- centered around stationary point
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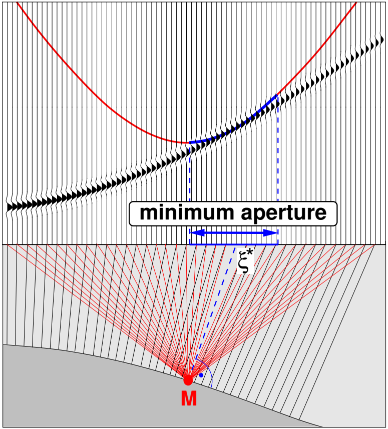

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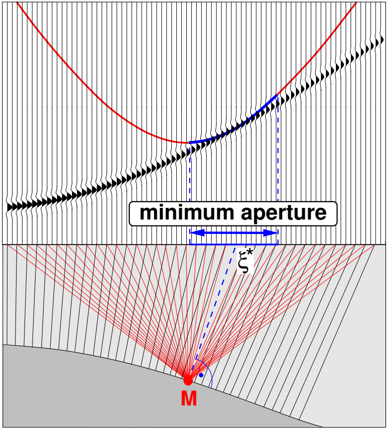

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Common-Reflection-Surface stack

- alternative to standard NMO/DMO/stack approach
- second-order approximation of reflection events in offset and midpoint direction
- spatial stacking operator
  - much more prestack traces used
    enhanced signal/noise ratio
- fully automated coherence-based application
- output:
  - zero-offset section/volume
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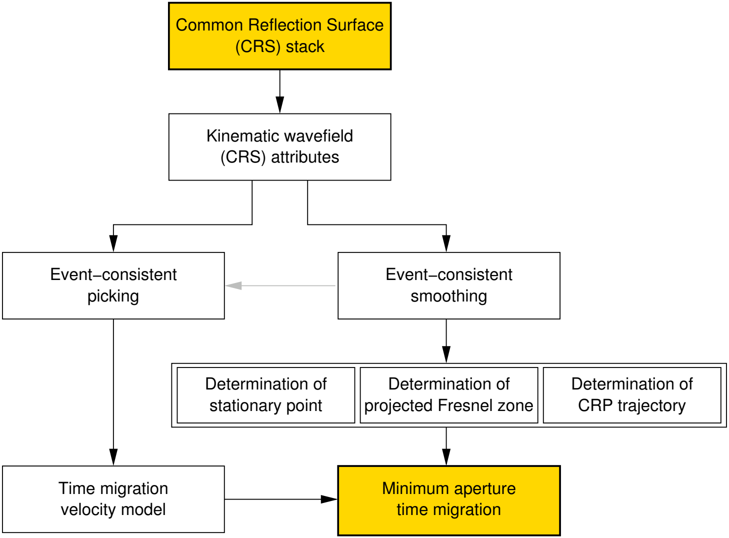
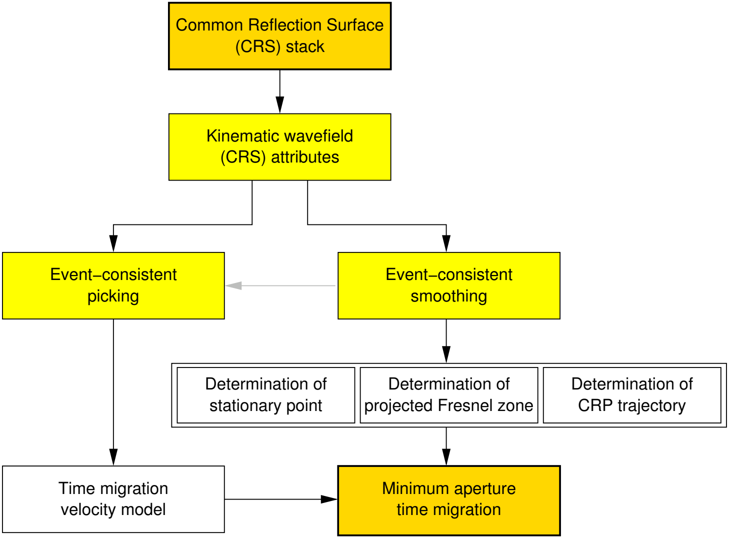
General workflow



Workflow: extraction of attributes



Workflow: extraction of attributes

CRS stack provides kinematic wavefield attributes for each sample

- meaningful only along reflection events
- subject to outliers
- subject to unphysical fluctuations

➥ attribute-based event-consistent smoothing

➥ smooth input for determination of PFZ and stationary point

➥ attribute-based event-consistent picking

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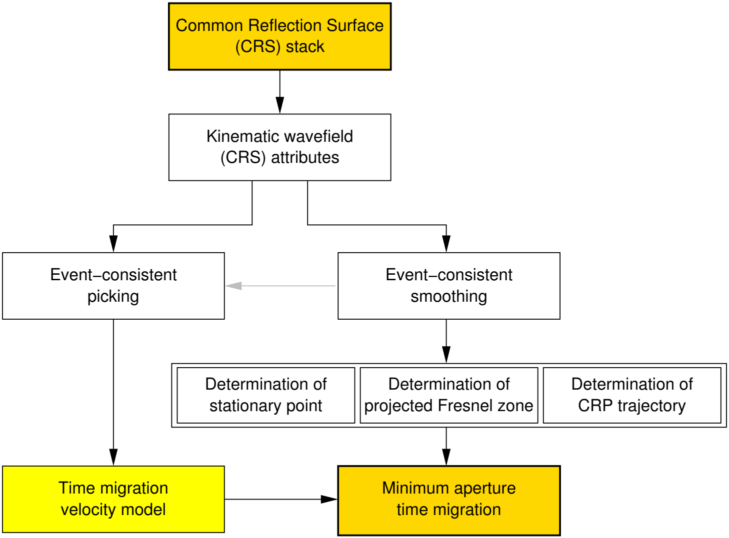

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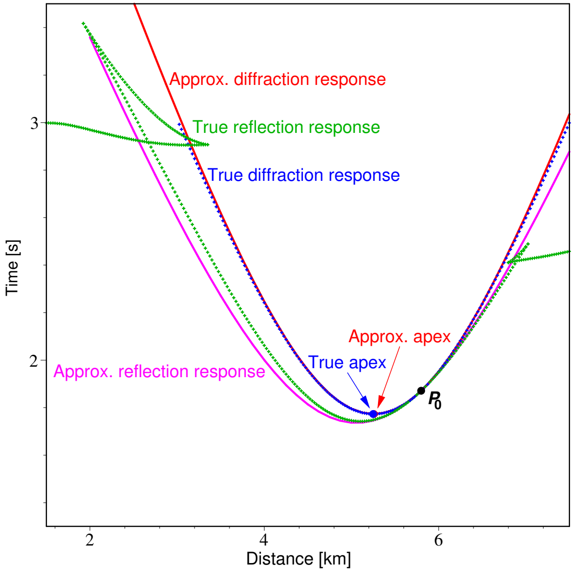

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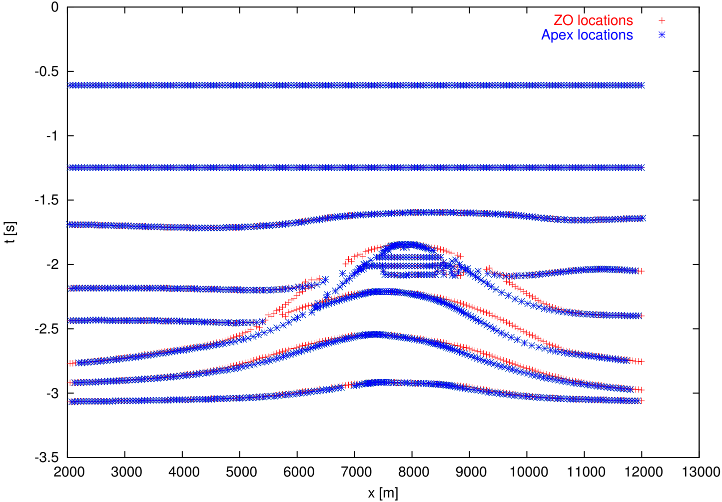

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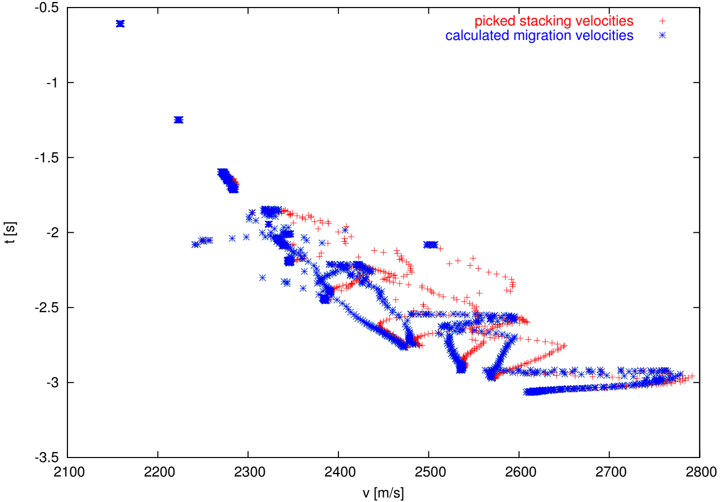

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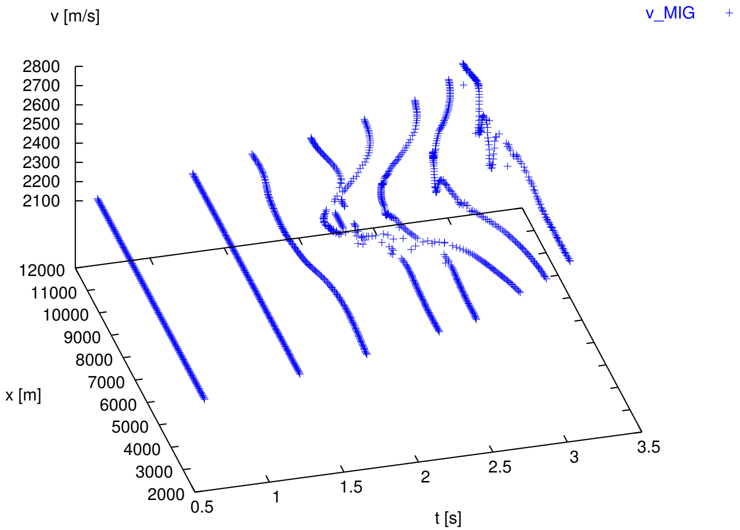

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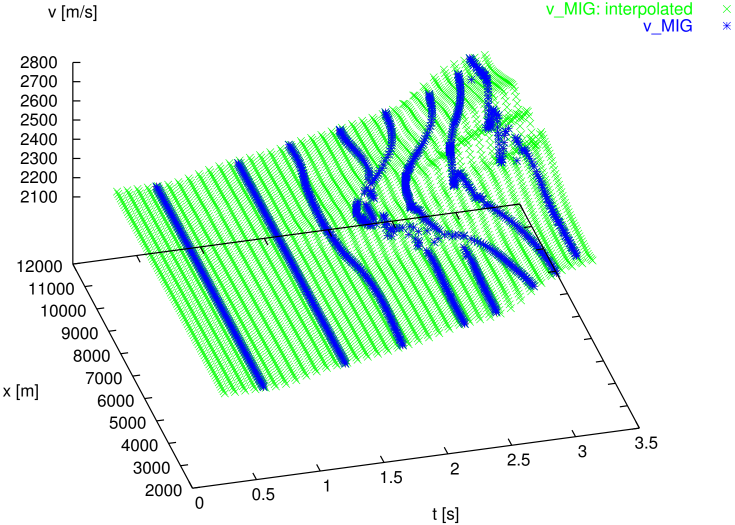
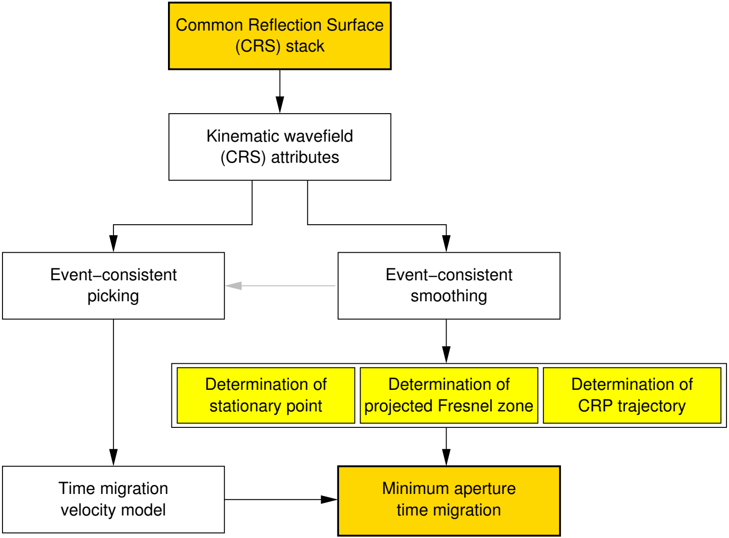


Workflow: migration attributes



PFZ & stationary point

Stationary point for ZO:

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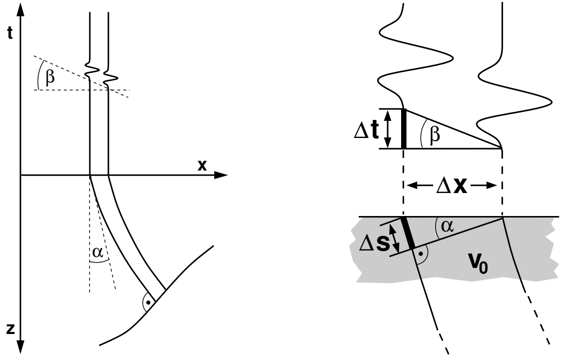

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➥ minimum dip difference below given threshold determines stationary point

Projected Fresnel zone for ZO:

➥ directly available from CRS attributes

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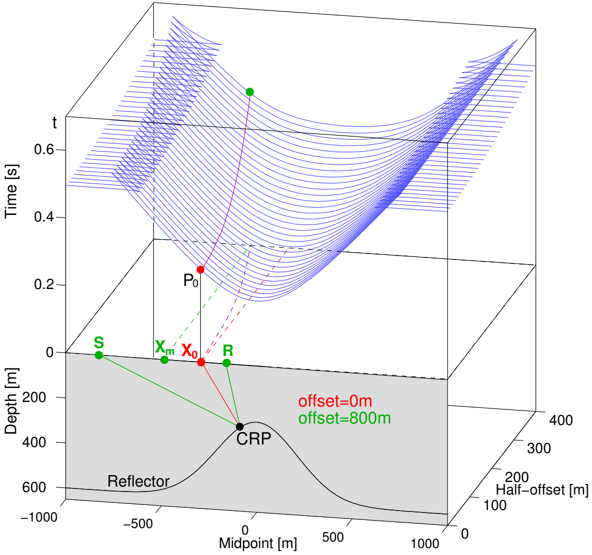
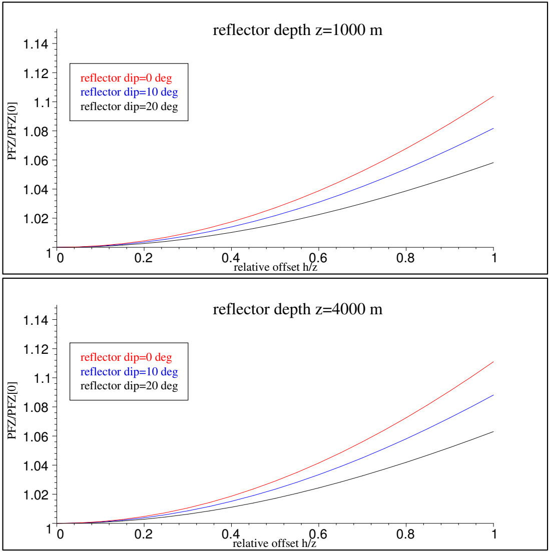
Common-Reflection-Point trajectory

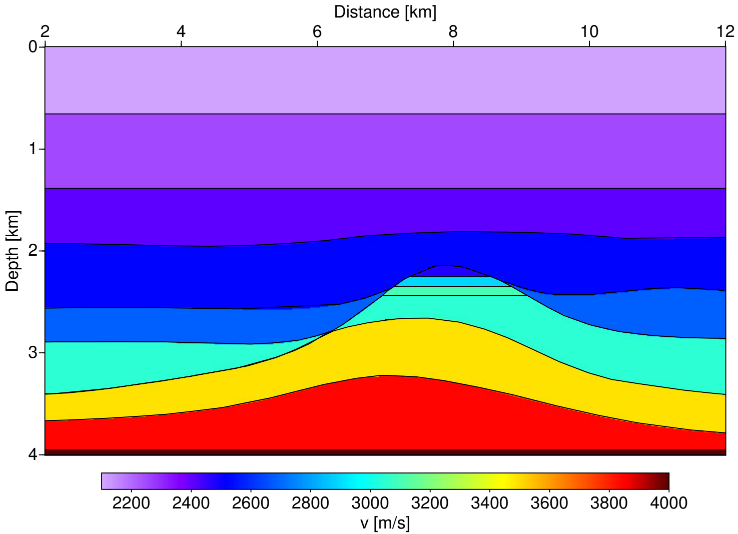


➥ extrapolation of stationary point to finite offset

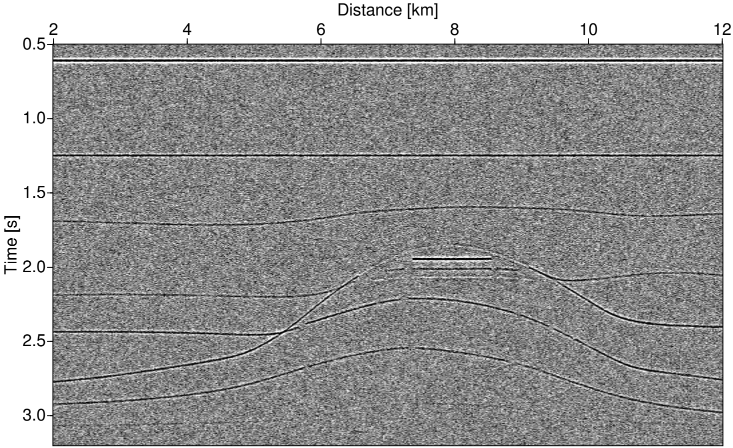
Widening of PFZ size with offset



Original model (v_P)



Zero-offset seismogram



Migration velocity model

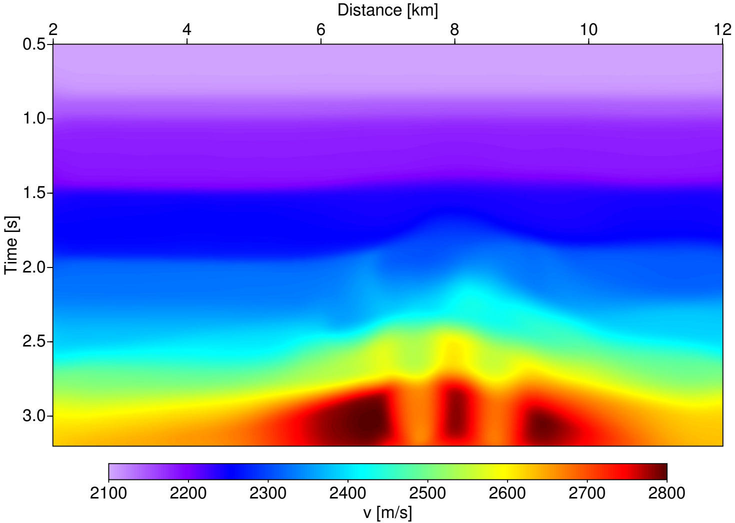
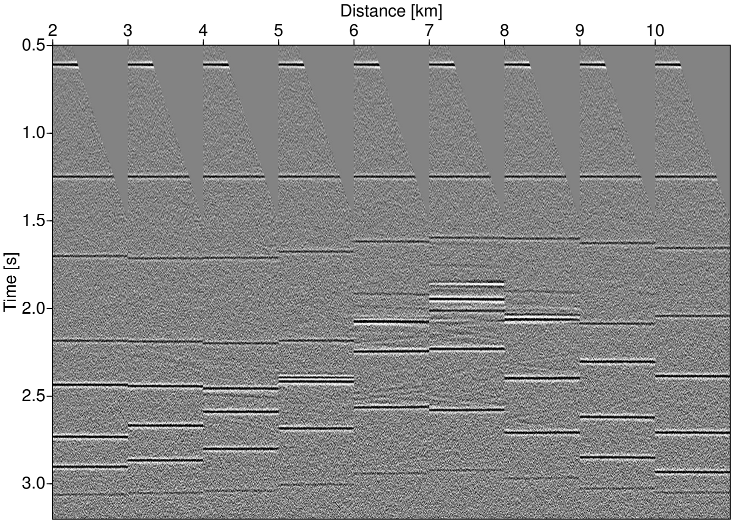
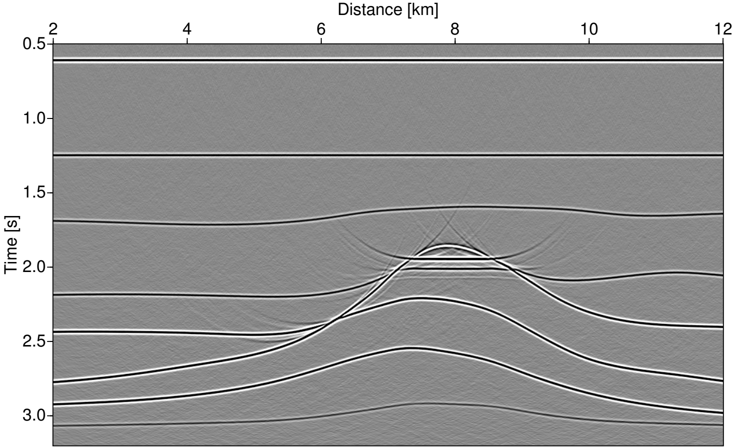


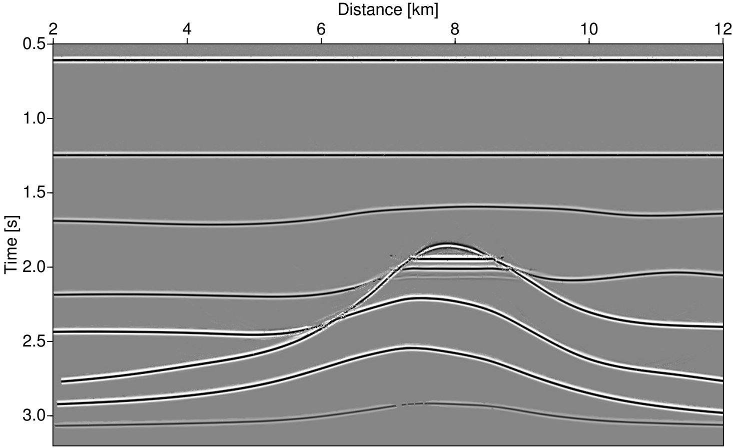
Image gather



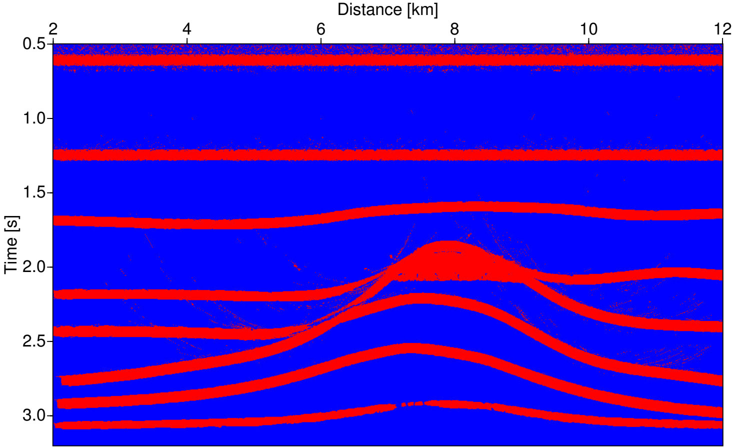
PreSTM stacked section (conventional)



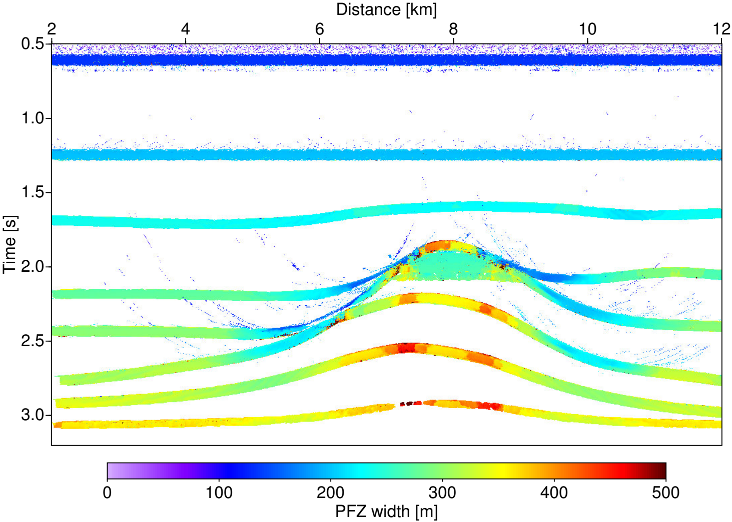
PreSTM stacked section (CRS-based)



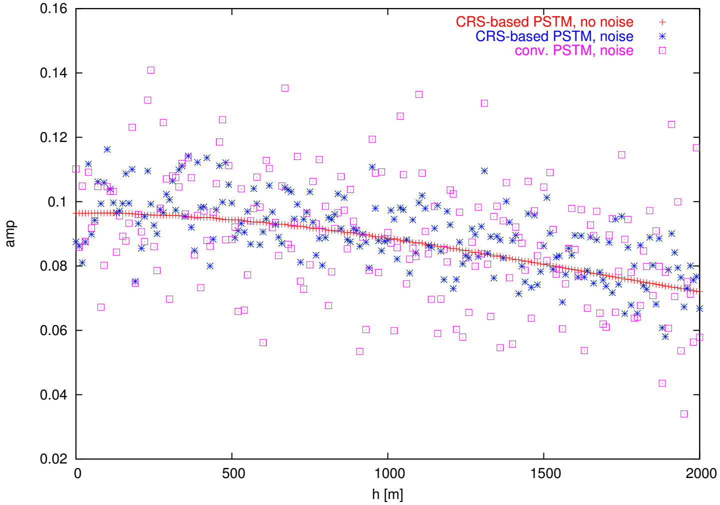
CRS-based stationary points



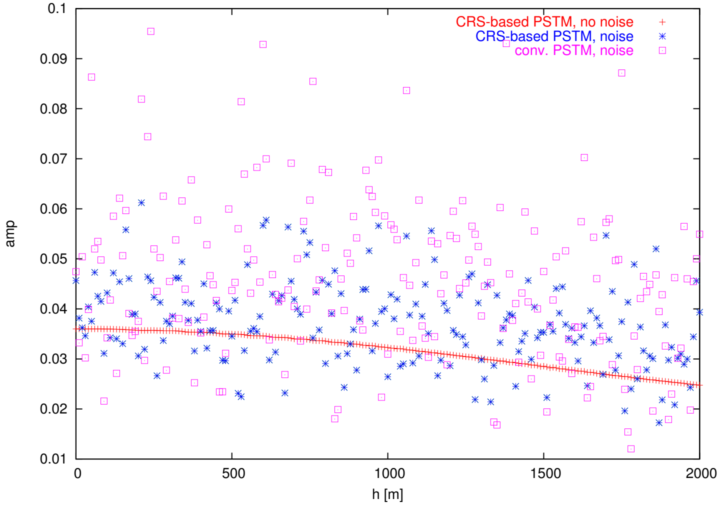
CRS-based ZO projected Fresnel zone



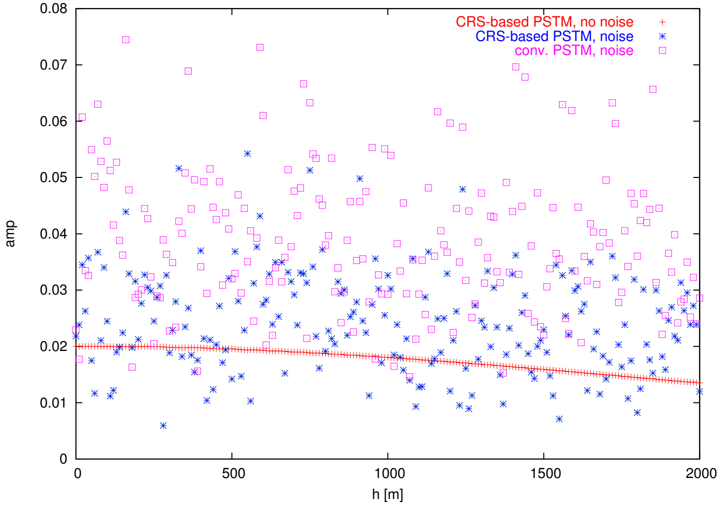
AVO (first target reflector)



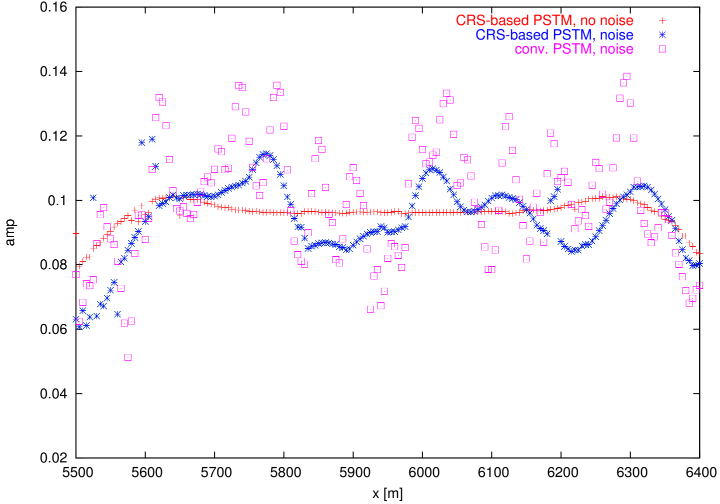
AVO (second target reflector)



AVO (third target reflector)



ZO amplitudes (first target reflector)



Conclusions

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Related presentations

Workshop WS-2 “Velocity analysis for depth imaging”, Monday afternoon:

- 13:30 Common-Reflection-Surface stack – a generalized stacking velocity analysis tool

Session “Seismic Imaging”, Wednesday morning:

- 09:20 Smoothing and automated picking of kinematic wavefield attributes
- 09:45 CRS-stack-based seismic imaging for land data and complex near-surface conditions
- 11:25 Common-Reflection-Surface stack for OBS and VSP geometries and multi-component seismic reflection data