Mapping and migrating reflected ground-roll

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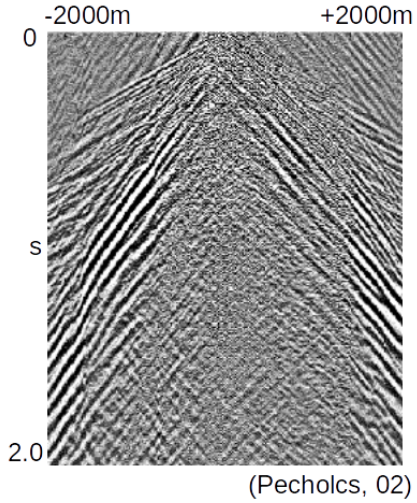
UNIVERSITY of HOUSTON

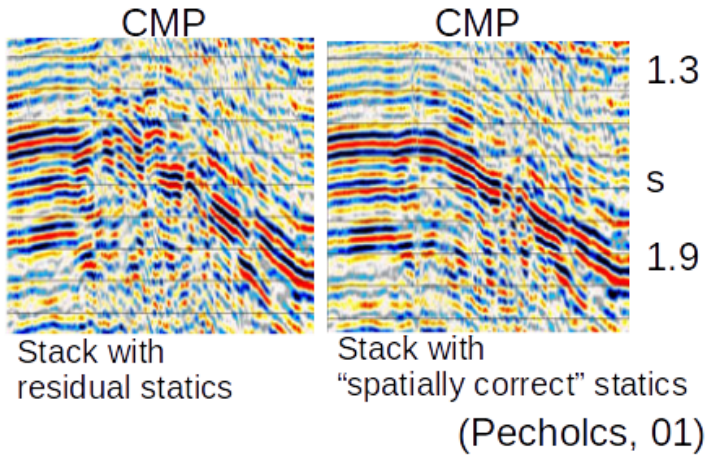
Outline: Ground-roll reflection

- Motivation
- Theory
- 2D fault imaging "in-line"
  - Synthetics
  - Field result
- 3D fault imaging "off-line"
  - Synthetics
- Summary

Motivation

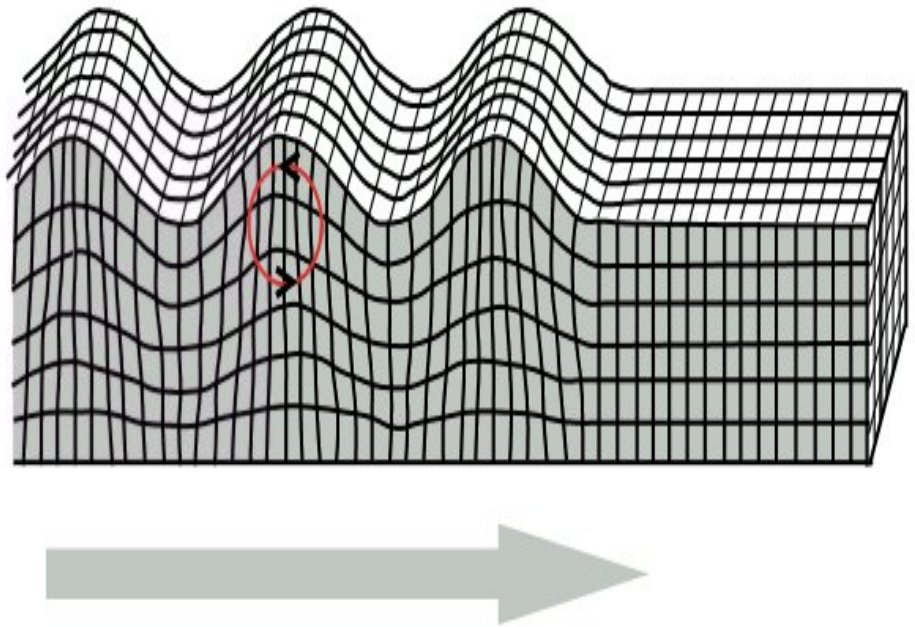
- Identify vertical-ish features
- Image lateral heterogeneity
- Determine velocity and statics
- Design better reject filters
- Discover near-surface anomalies

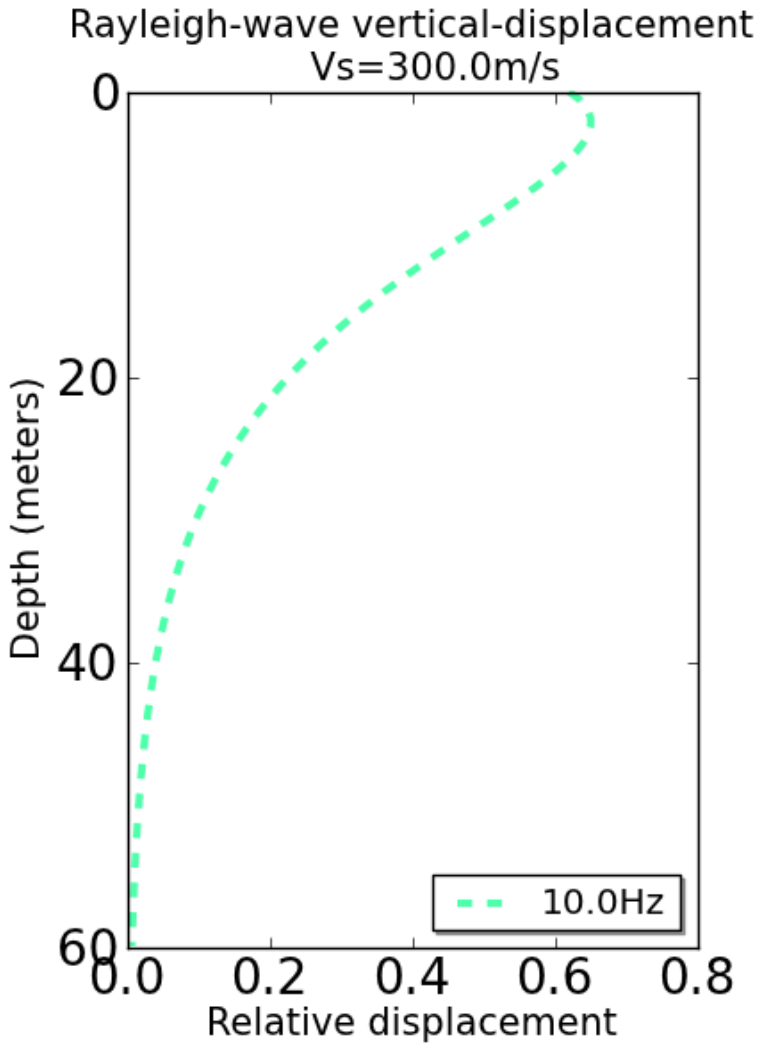




Theory

Ground-roll (Rayleigh-wave)





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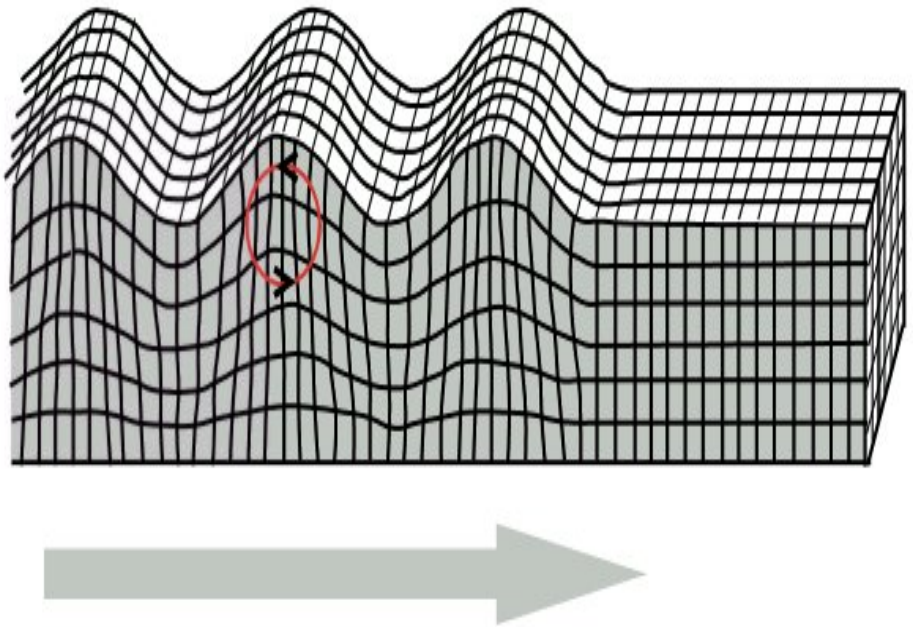
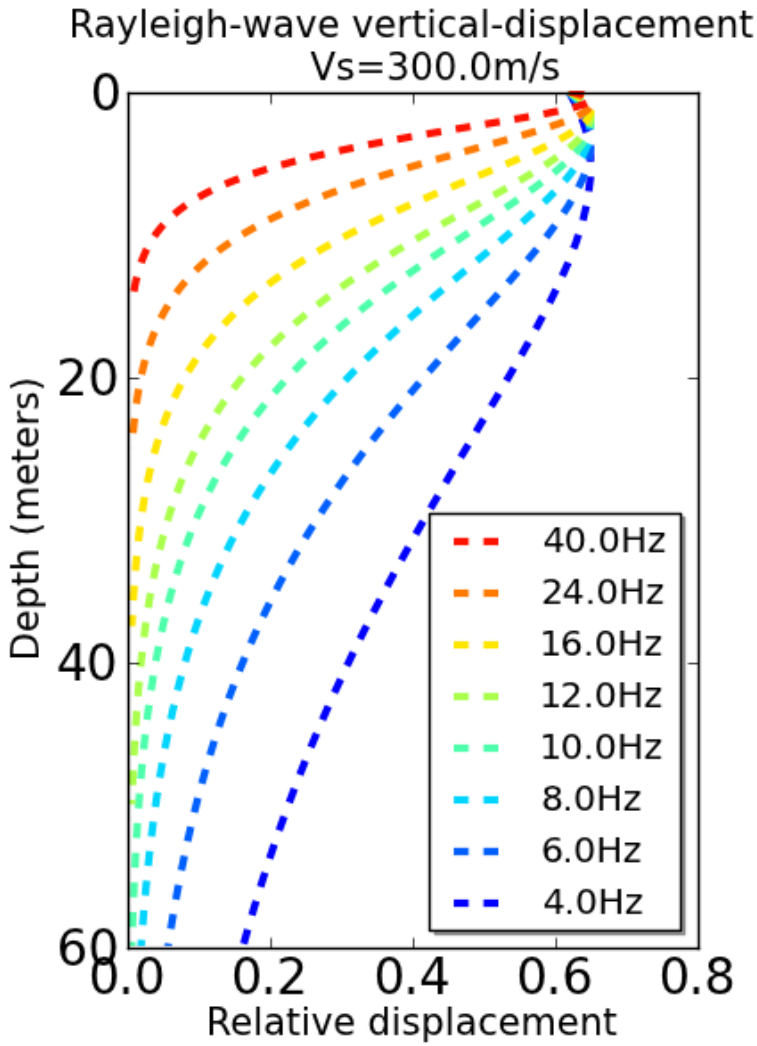
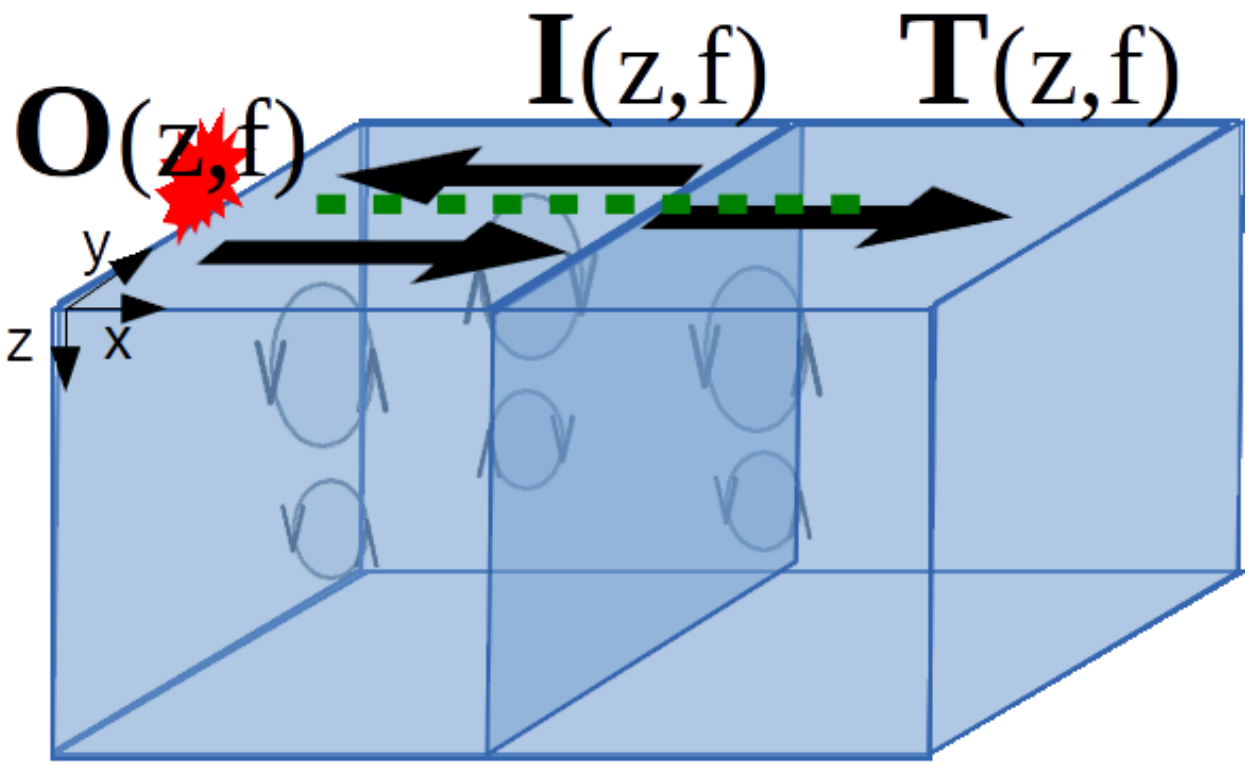




Back-reflected ground-roll



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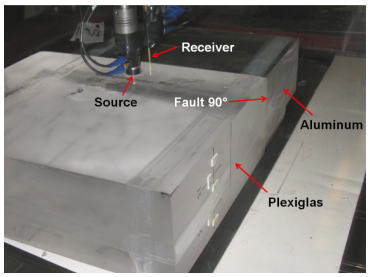
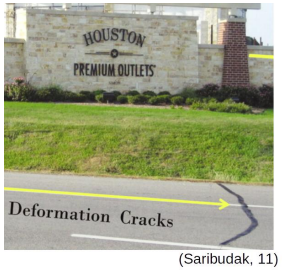
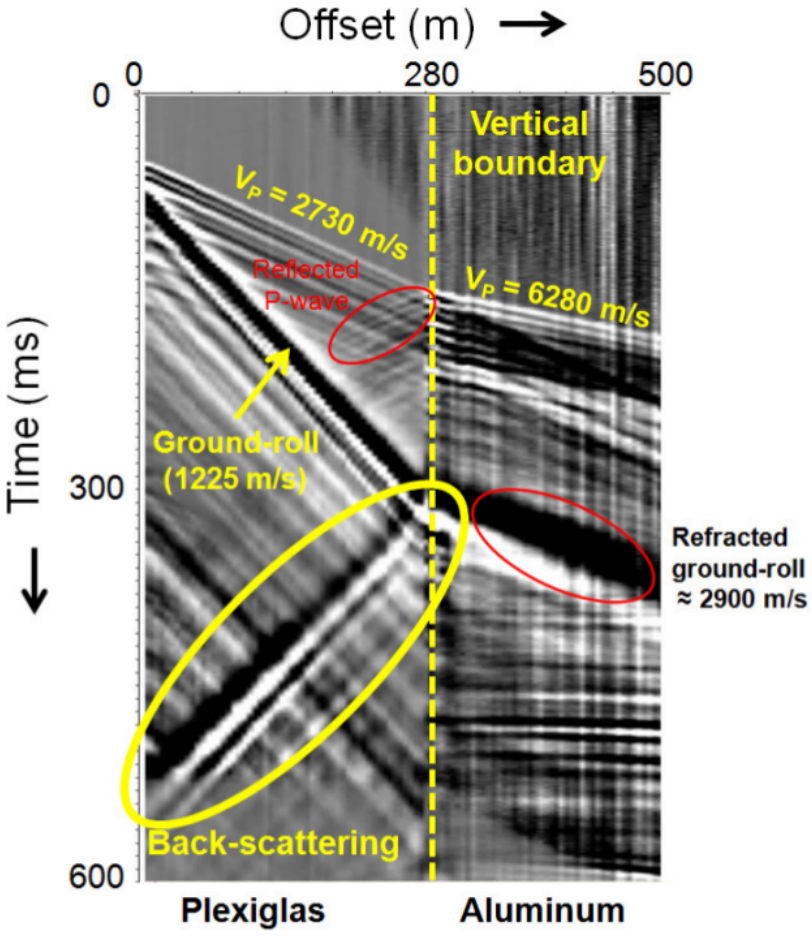
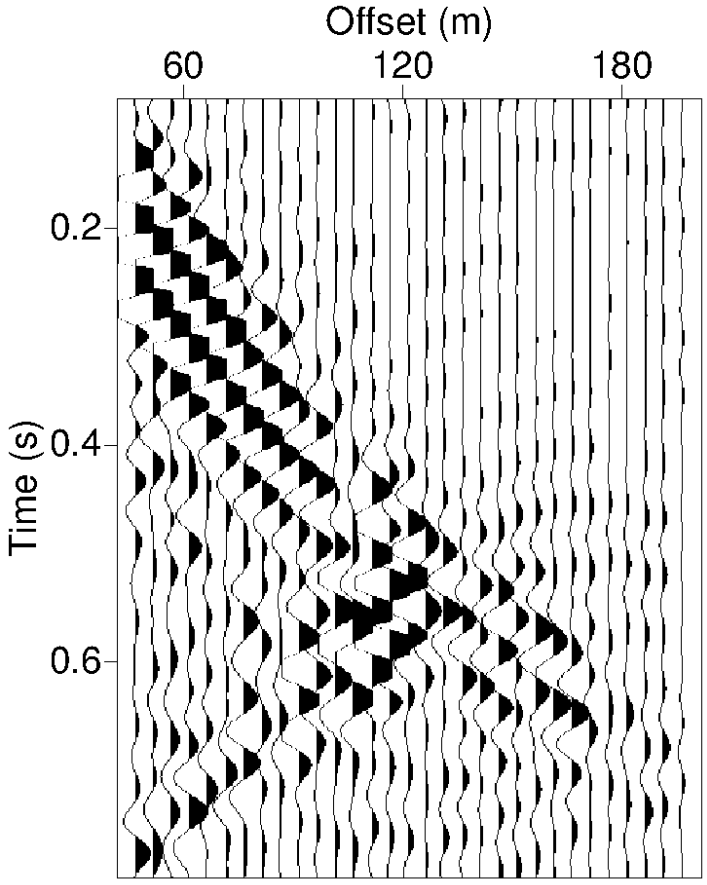




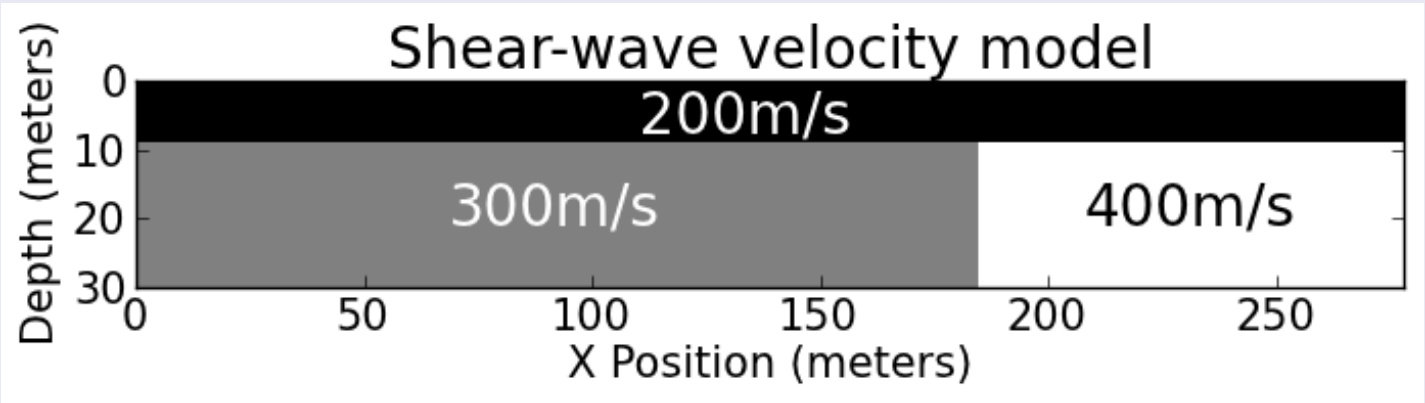
(Saribudak, 11)





2D fault imaging

Synthetic model and survey parameters

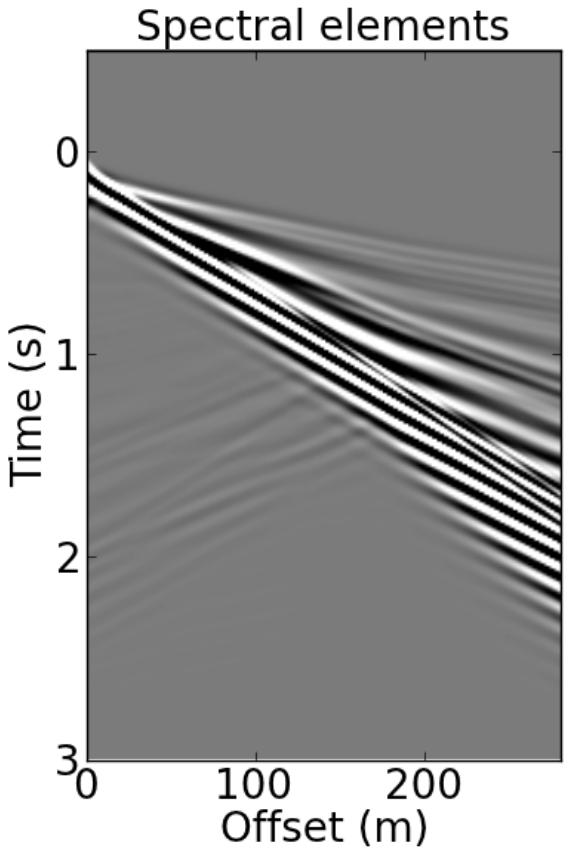


Source	10 Hz Ricker
Receiver	vertical component
Source interval	10 m
Receiver interval	1 m

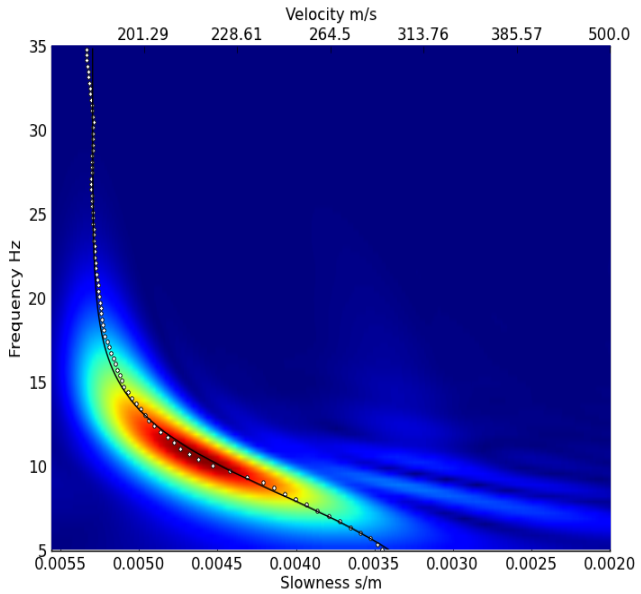
2D fault imaging

For dispersive surface-waves

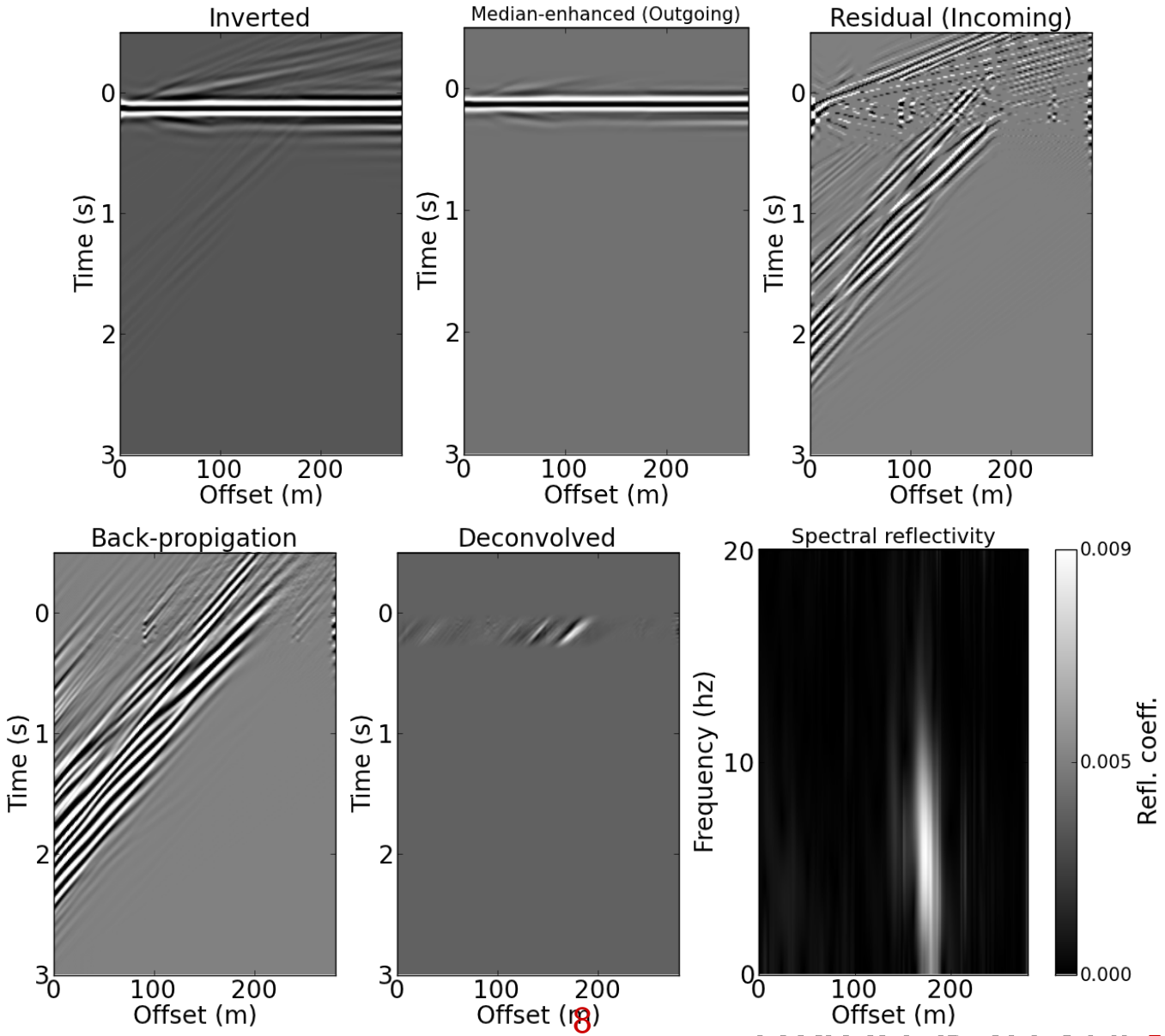
Phase-velocity is a function of frequency.



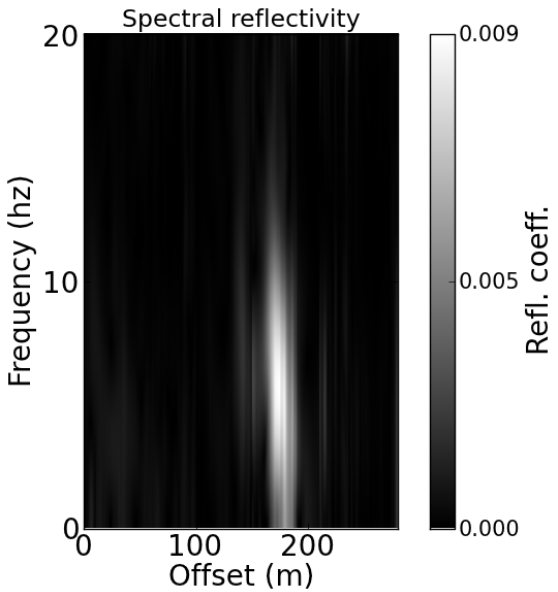
Extracted dispersion curve

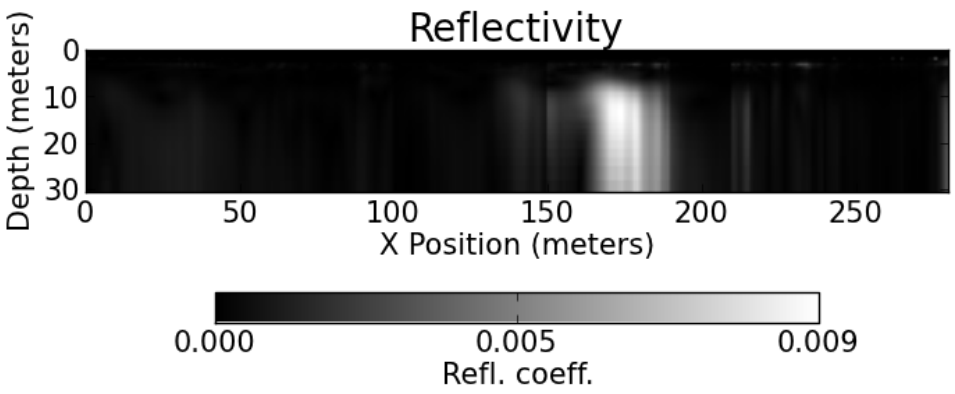


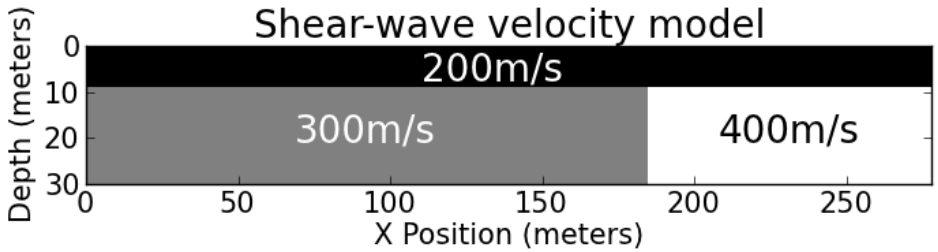
2D fault imaging: Processing



Reflectivity: Depth mapping

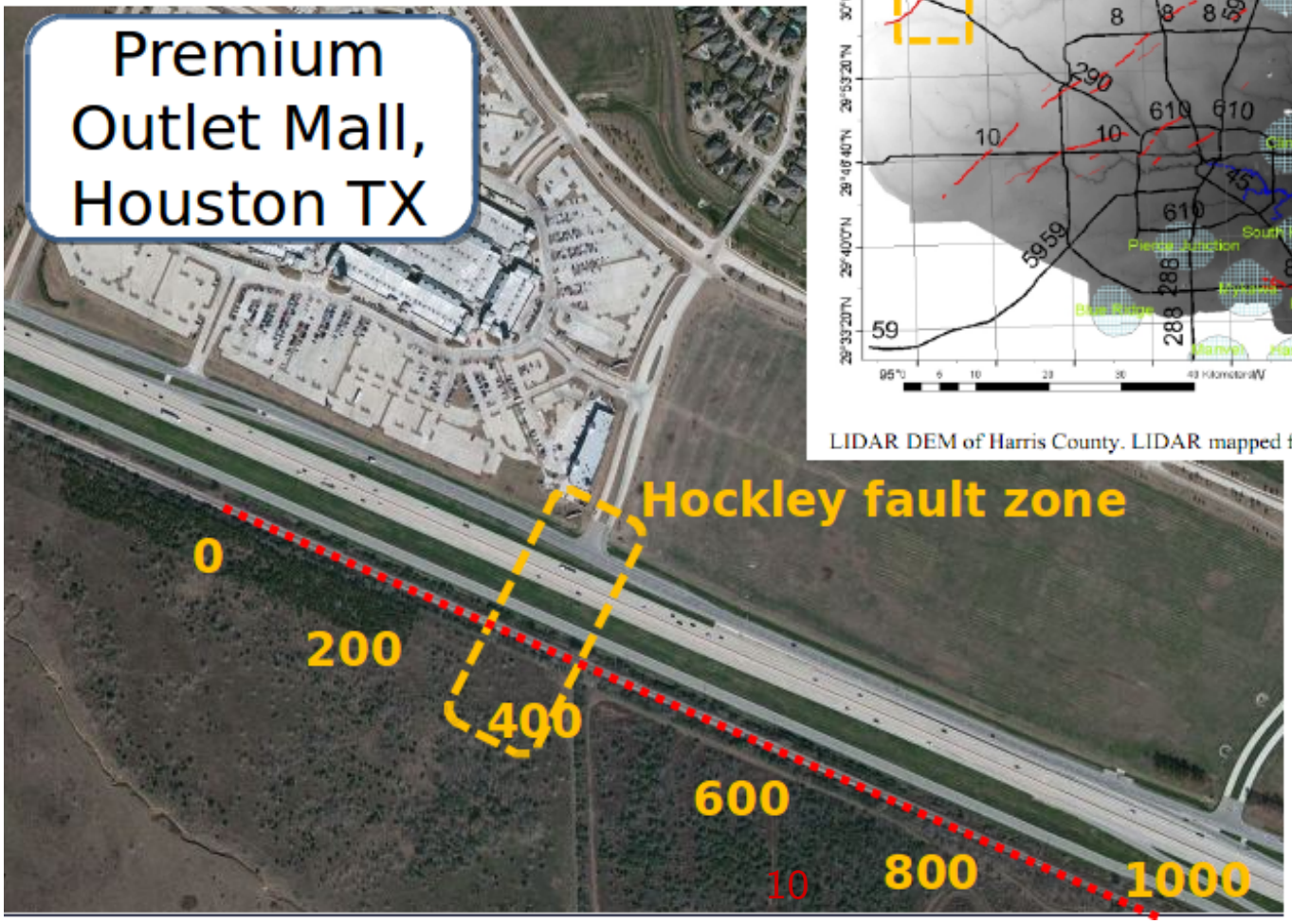


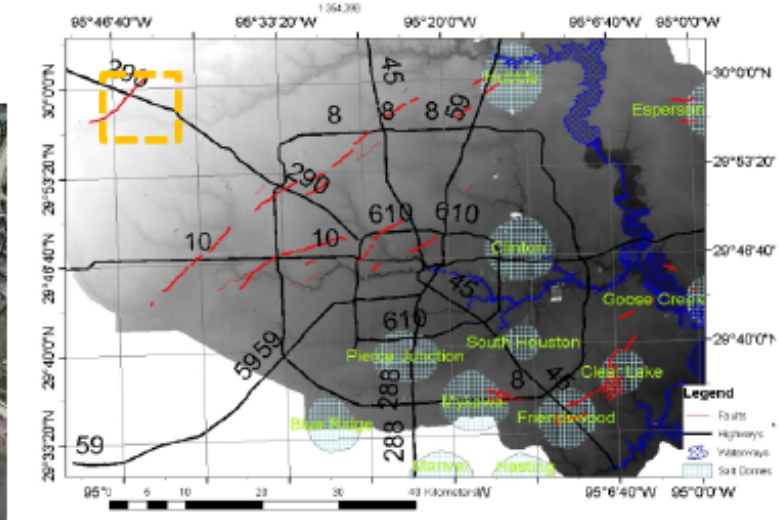




Field

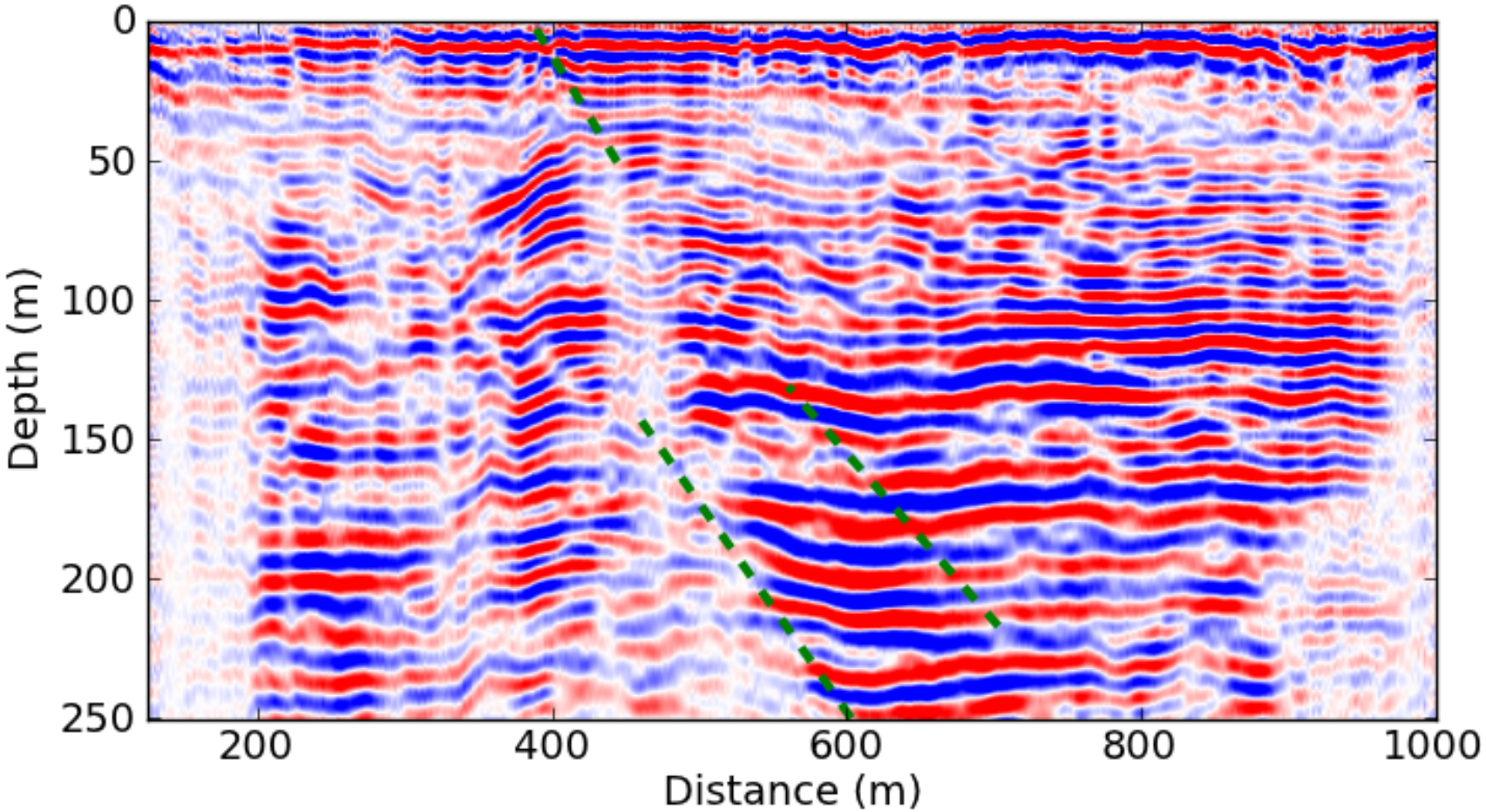
Source	vertical vib.
Receiver	vertical component processed
Source interval	5 m
Receiver interval	5 m



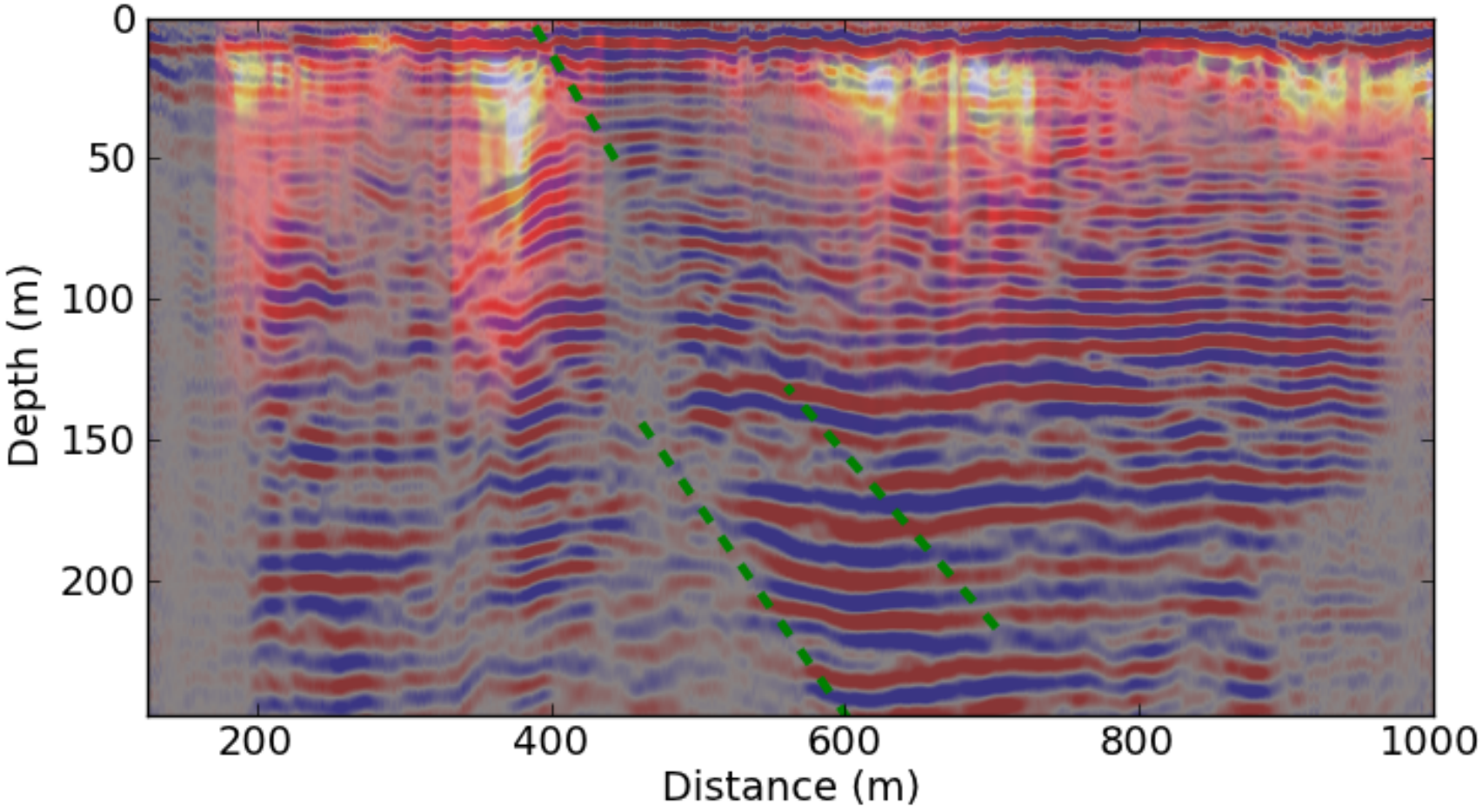


LIDAR DEM of Harris County. LIDAR mapped faults, salt dome locations.

Field result

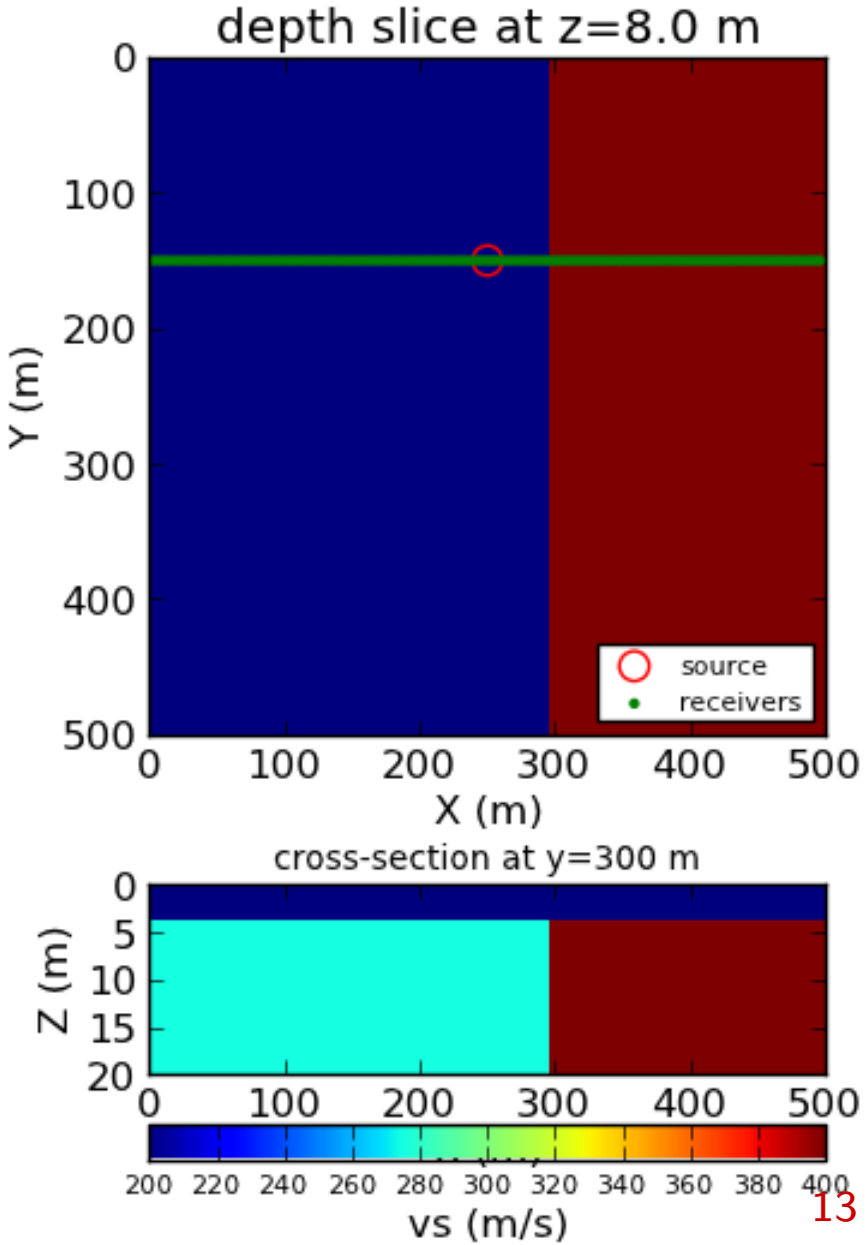


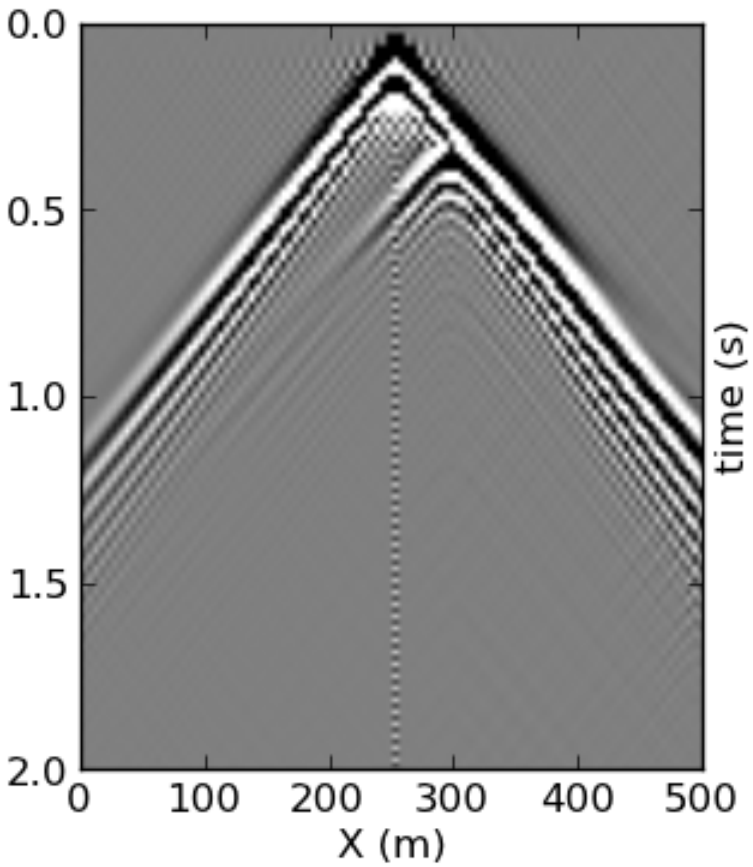
Field result



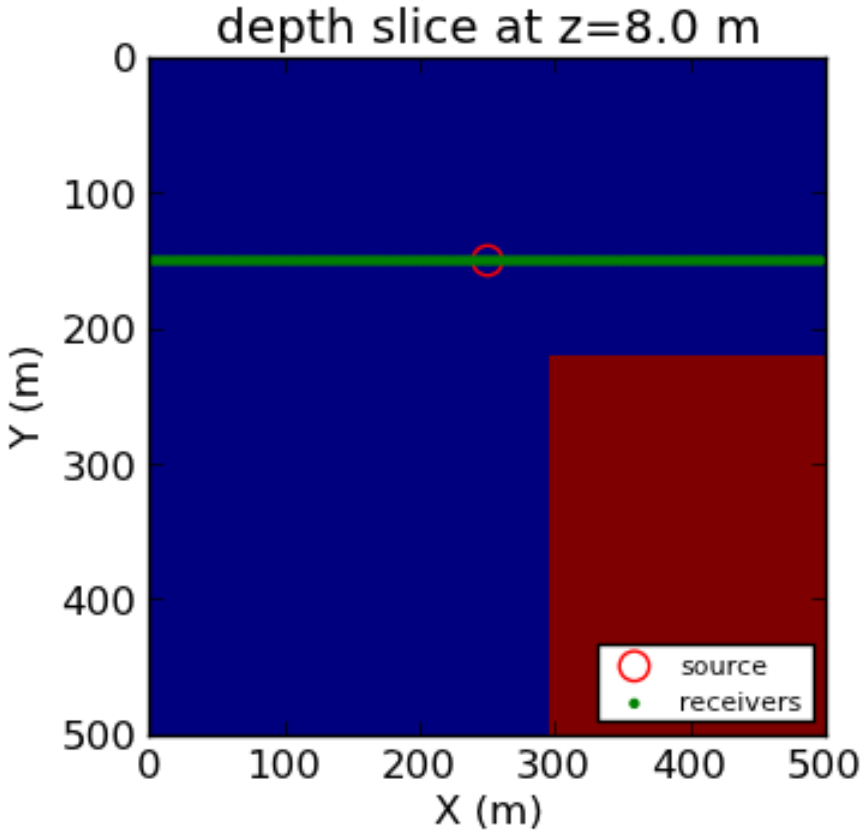
ON

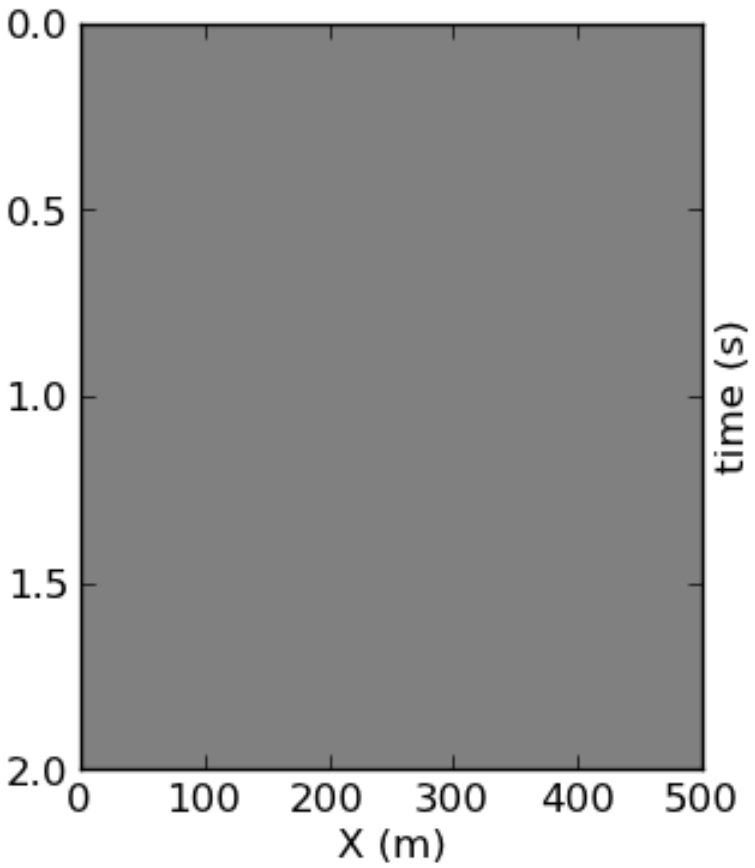
Fault in-line vs. off-line





Fault "off-line"





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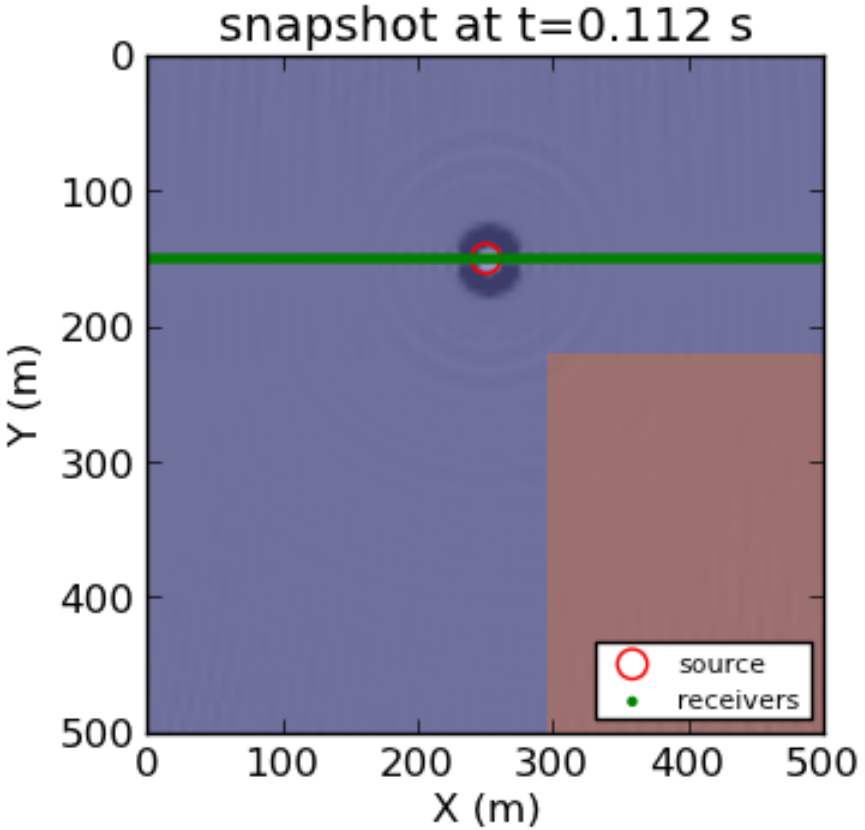

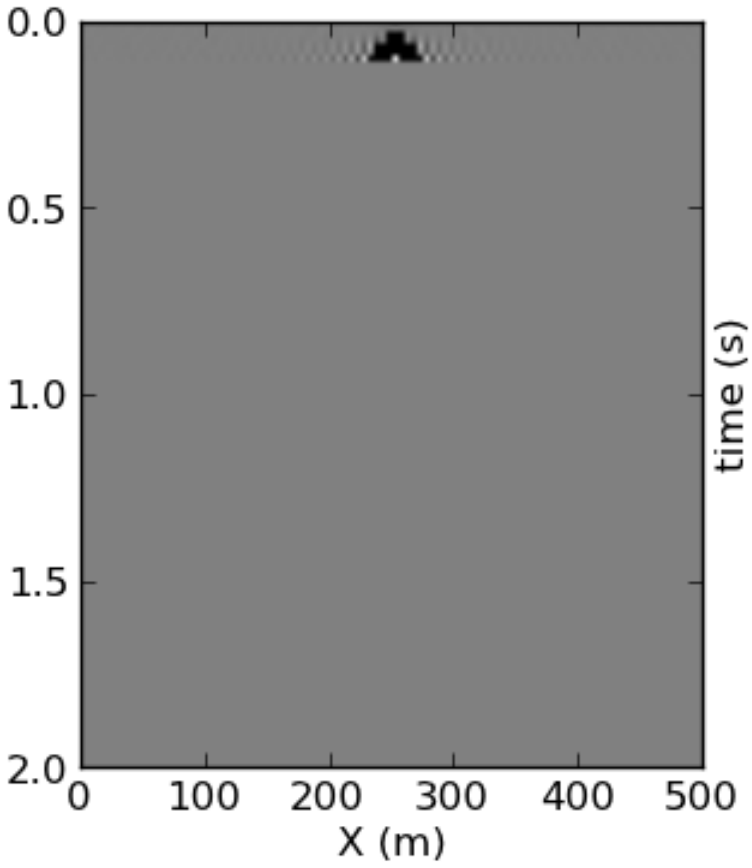

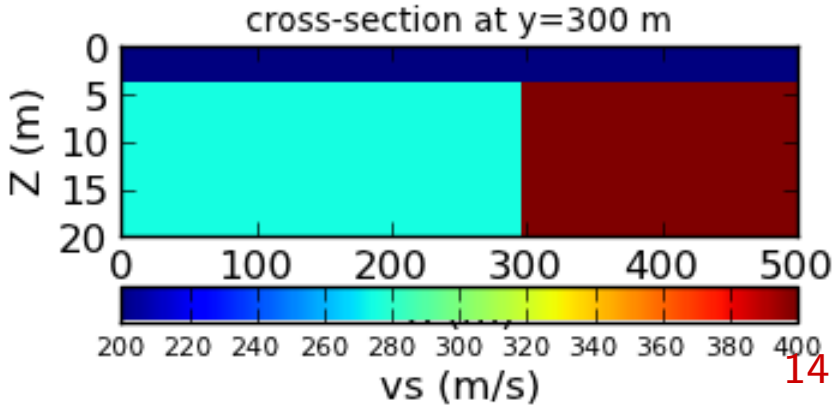

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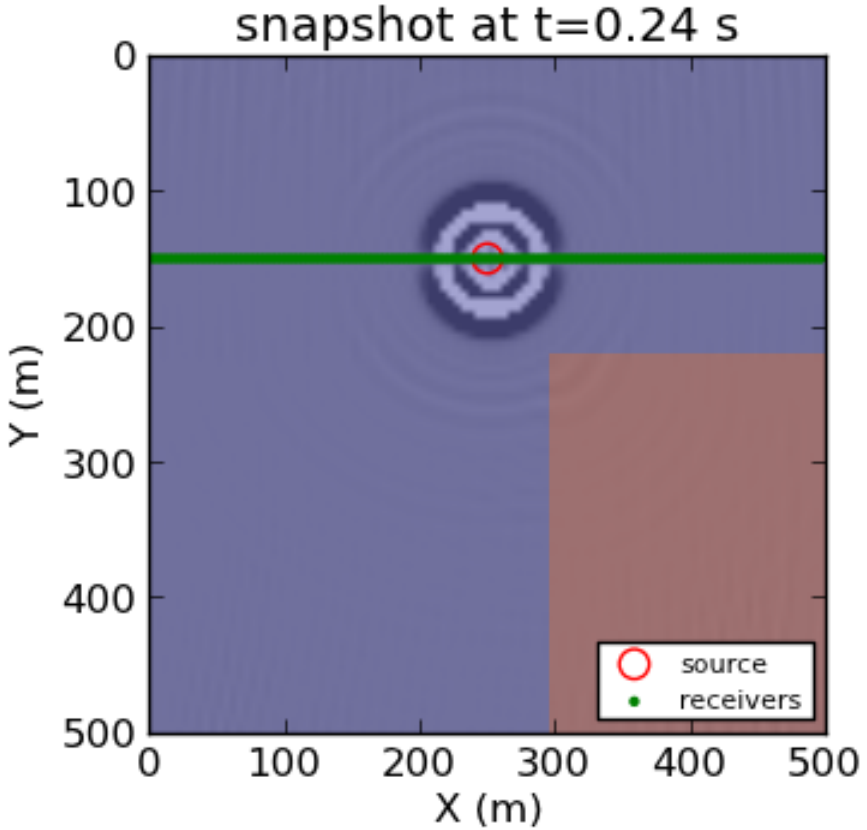

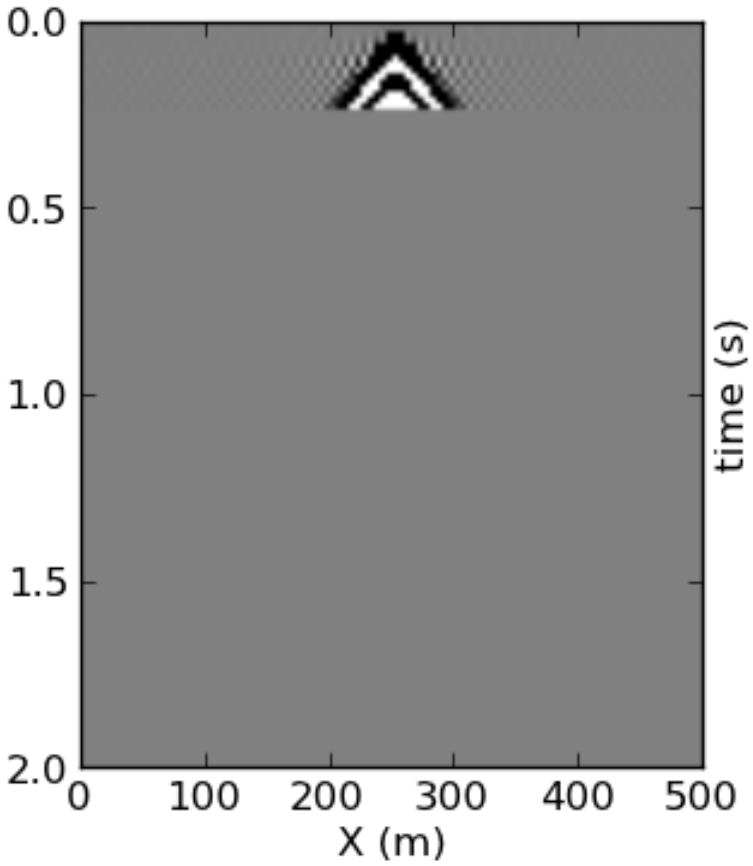

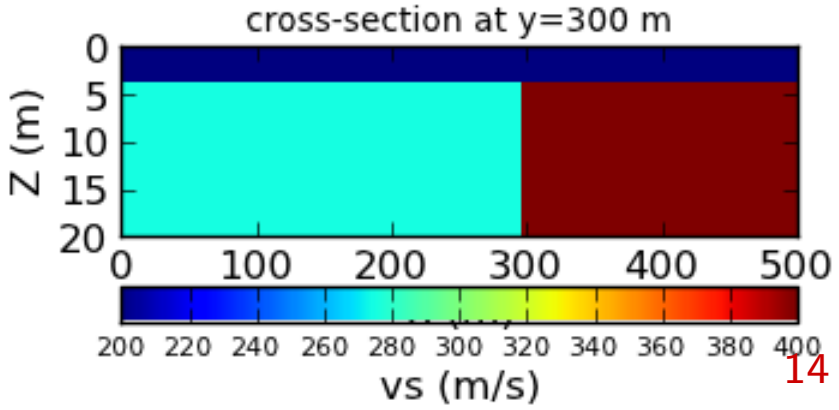

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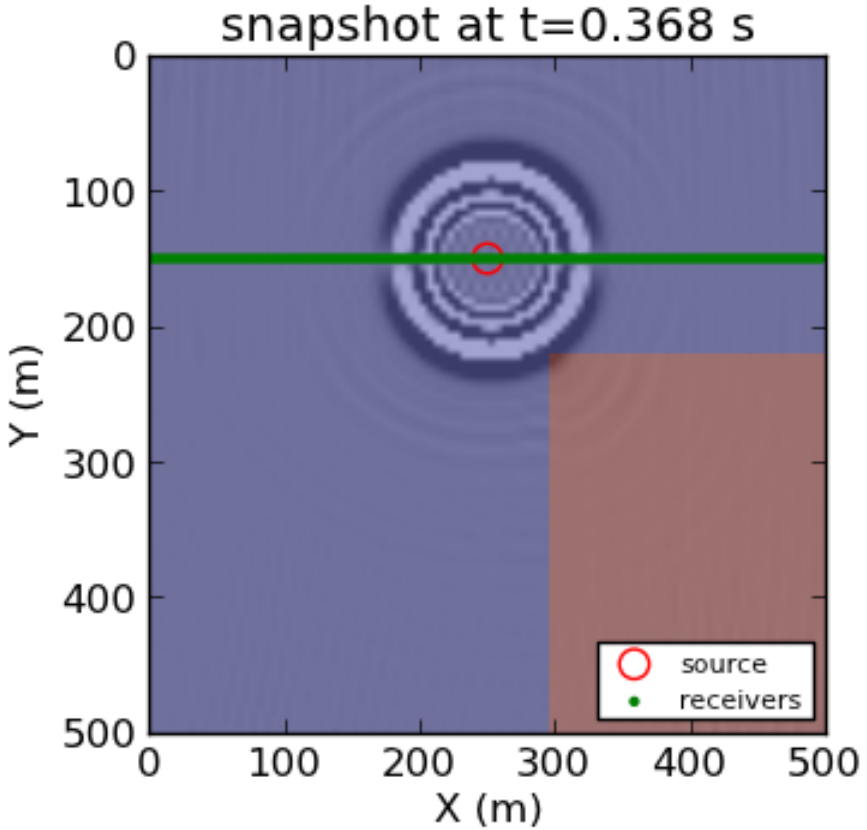

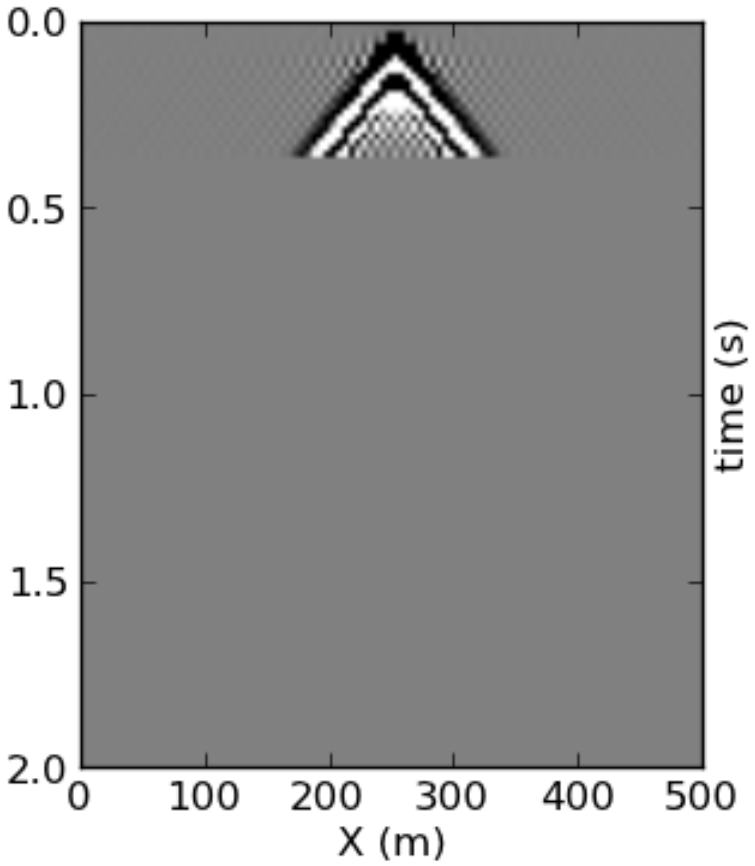

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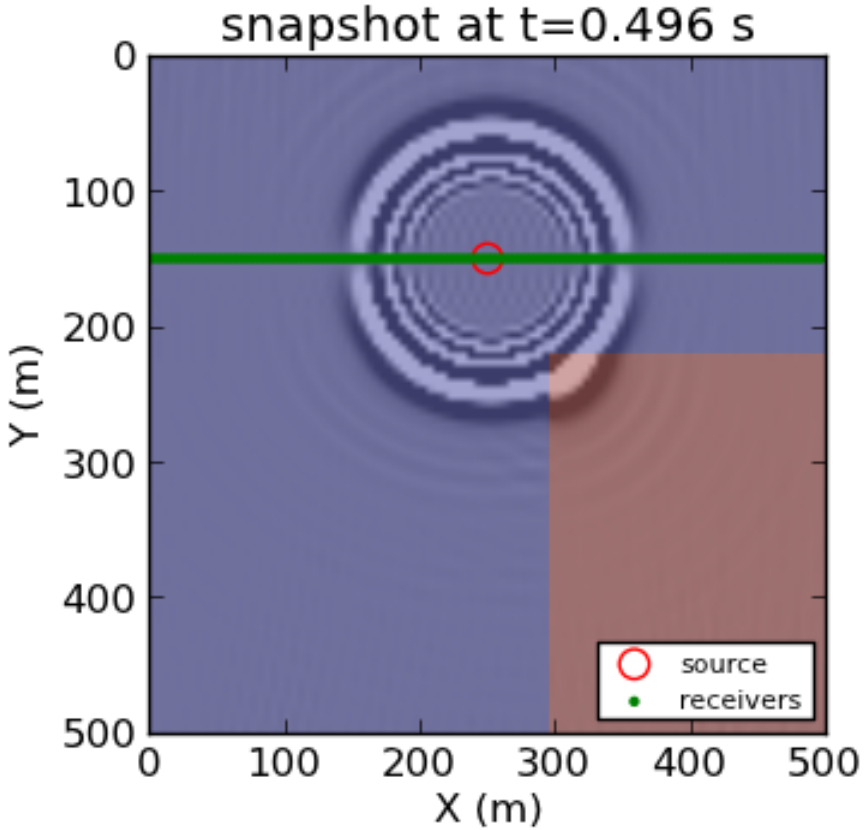

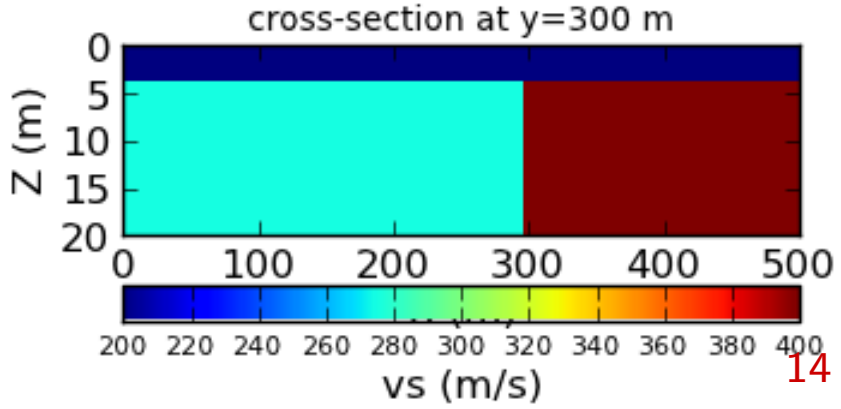

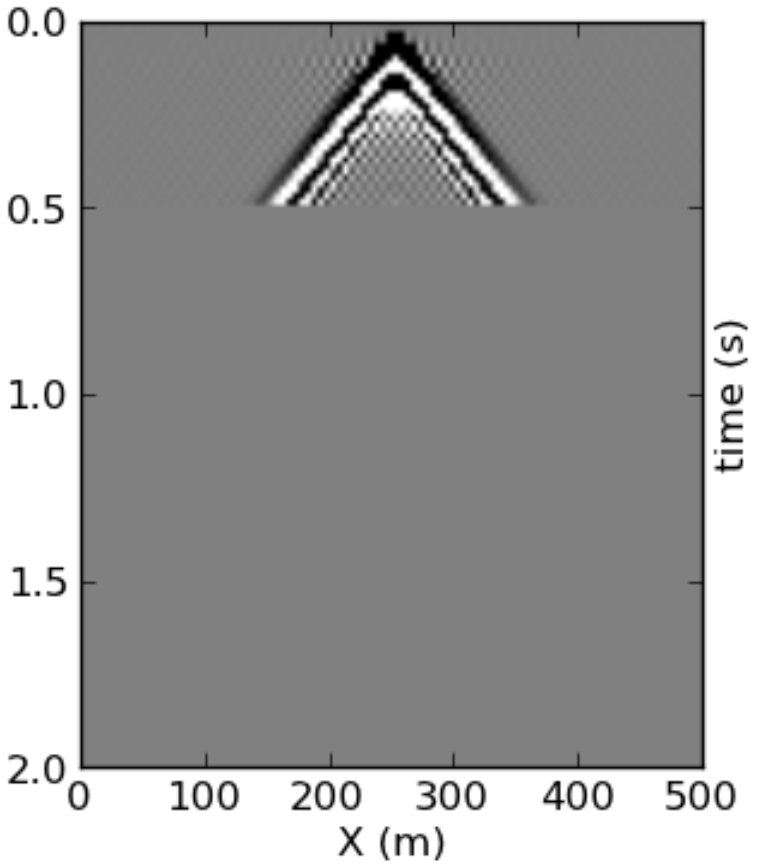

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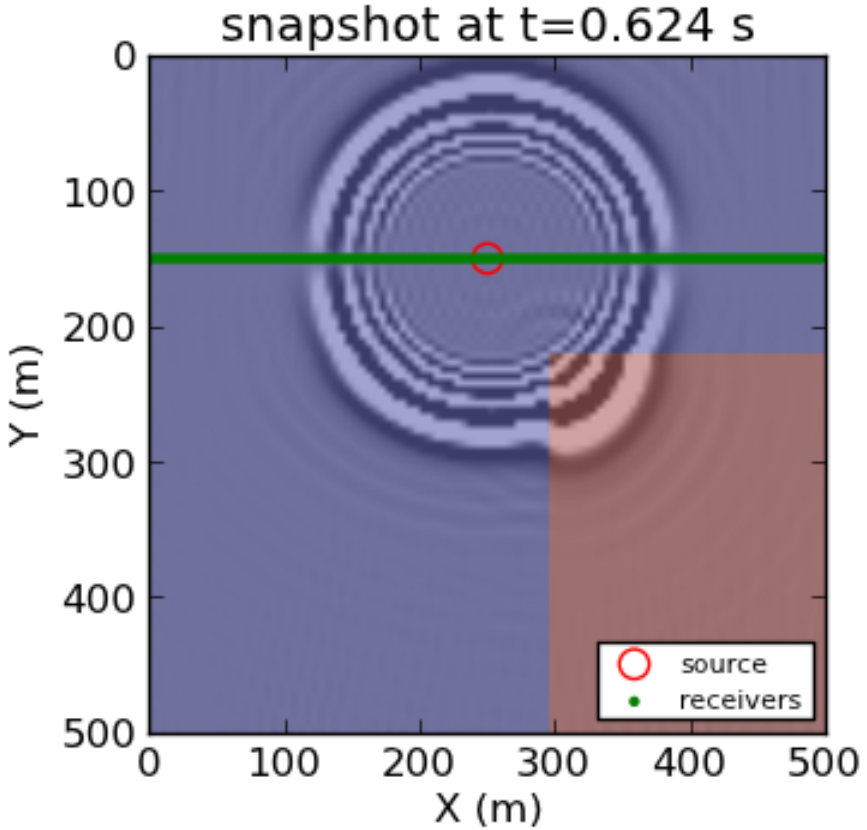

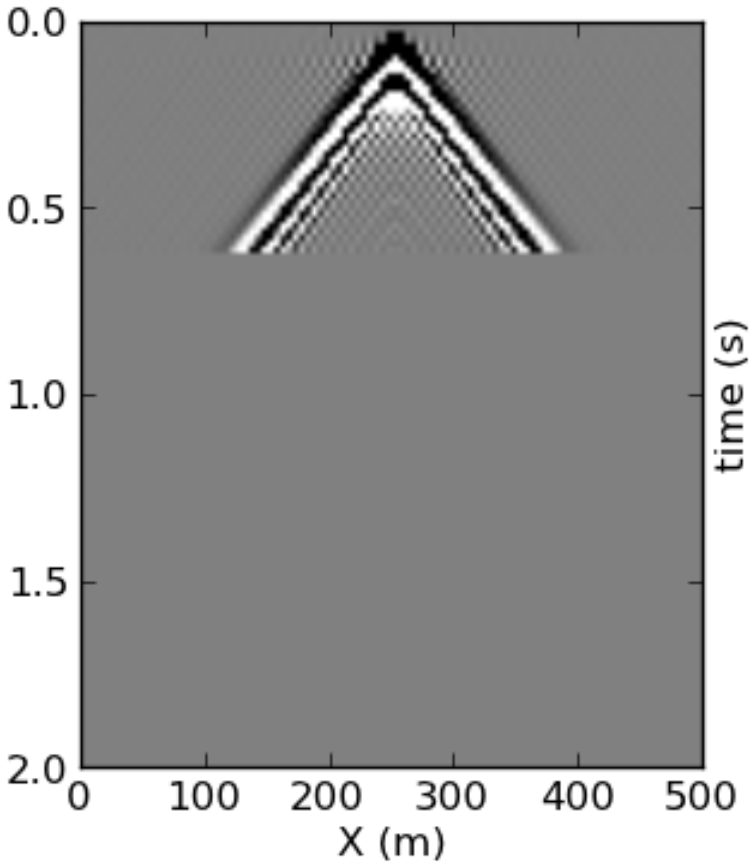

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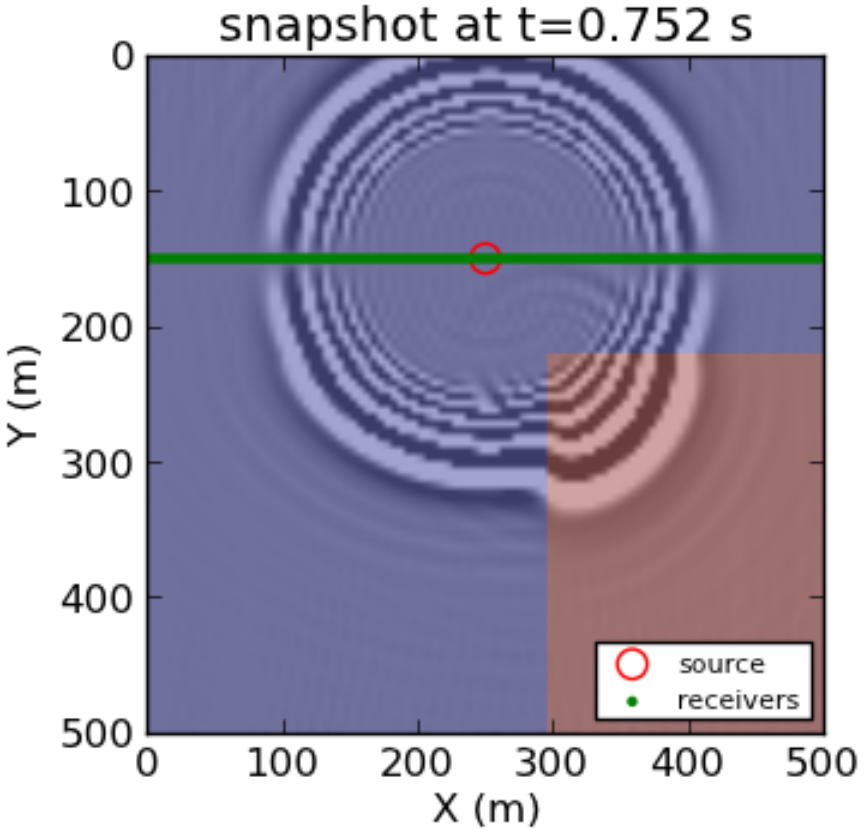

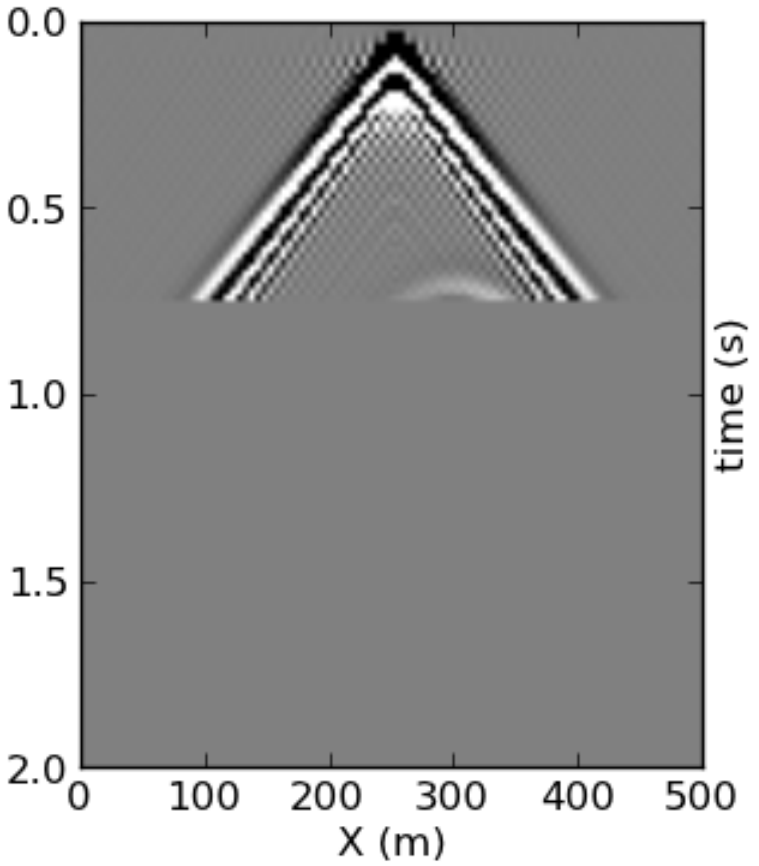

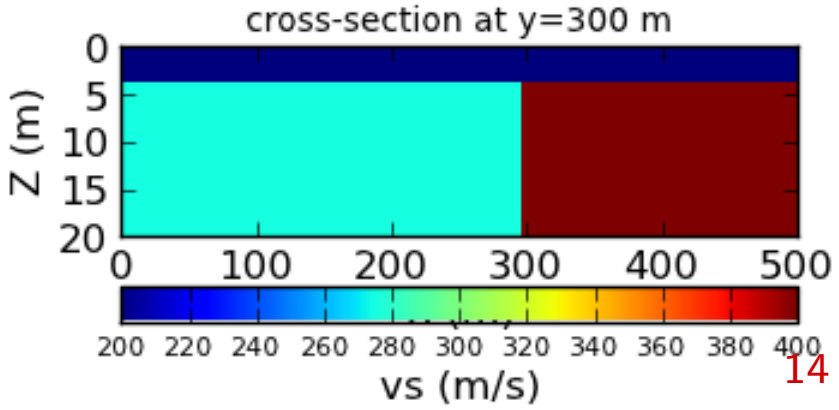

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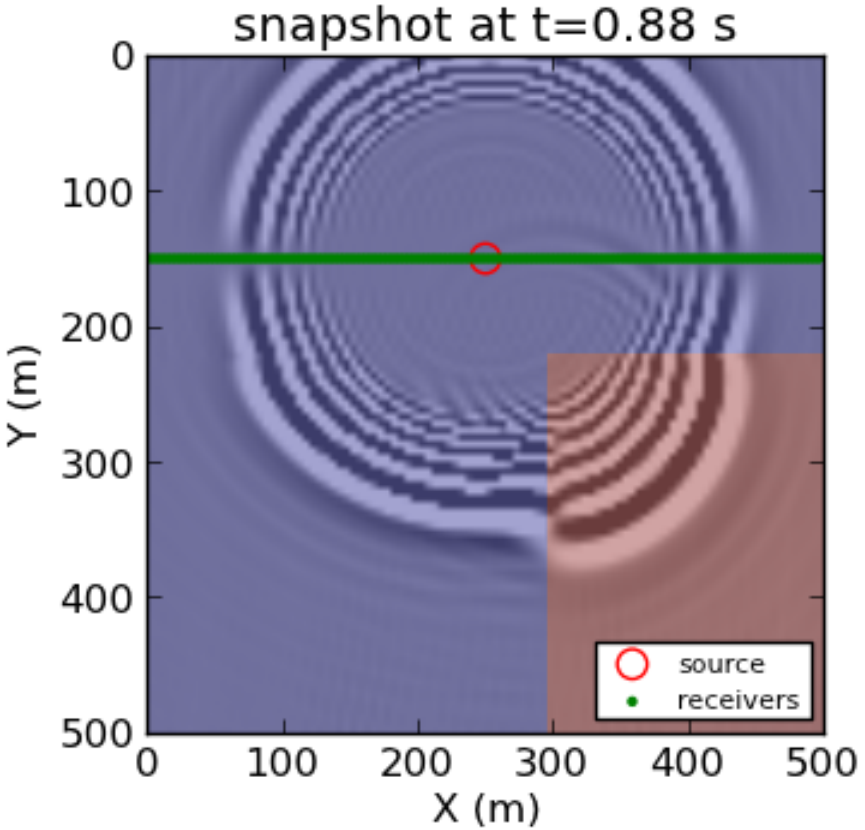

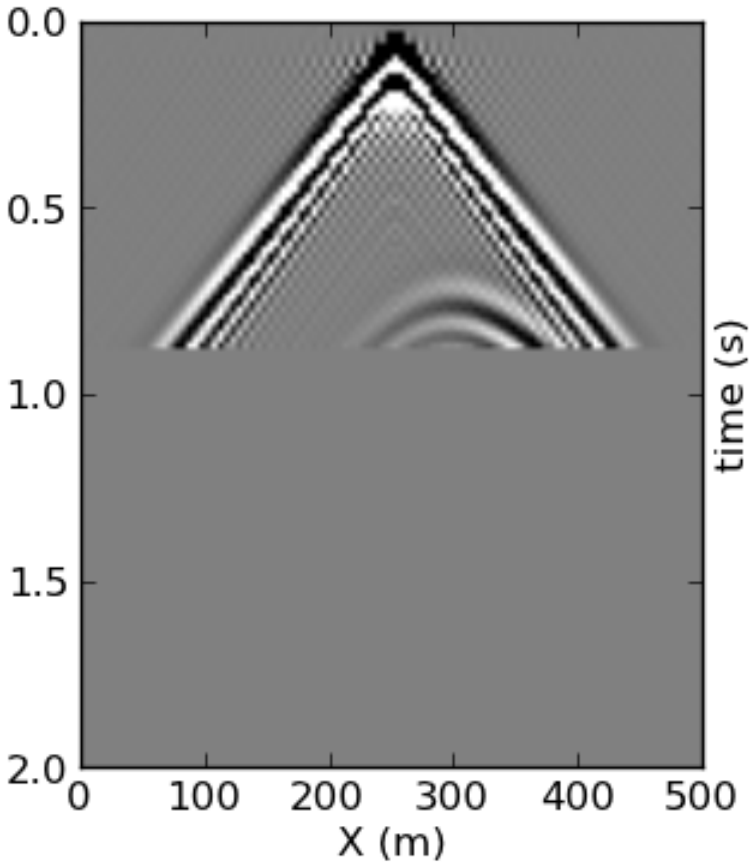

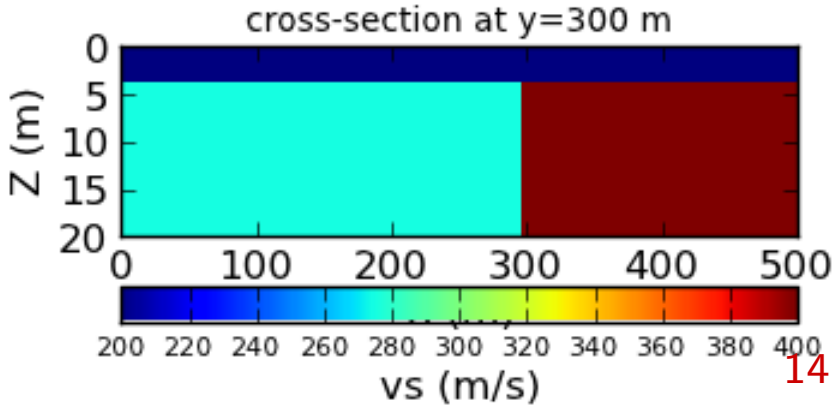

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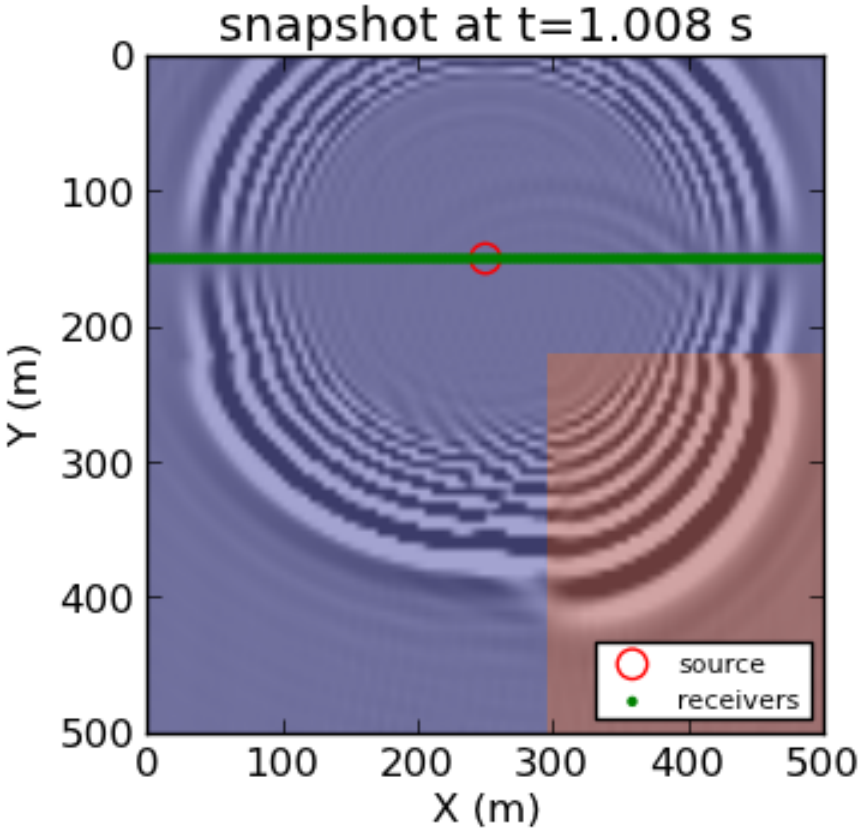

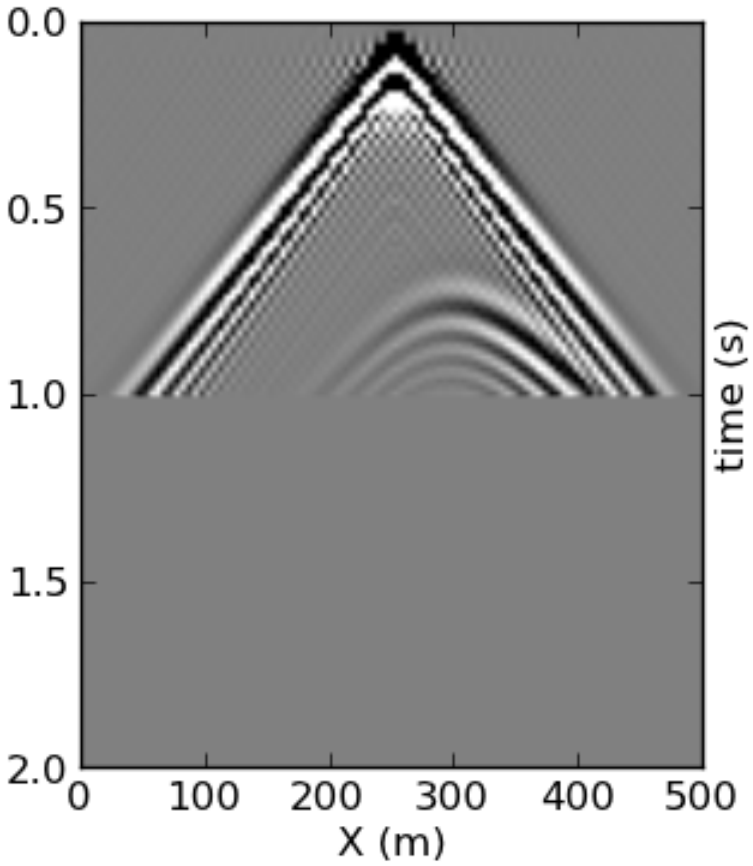

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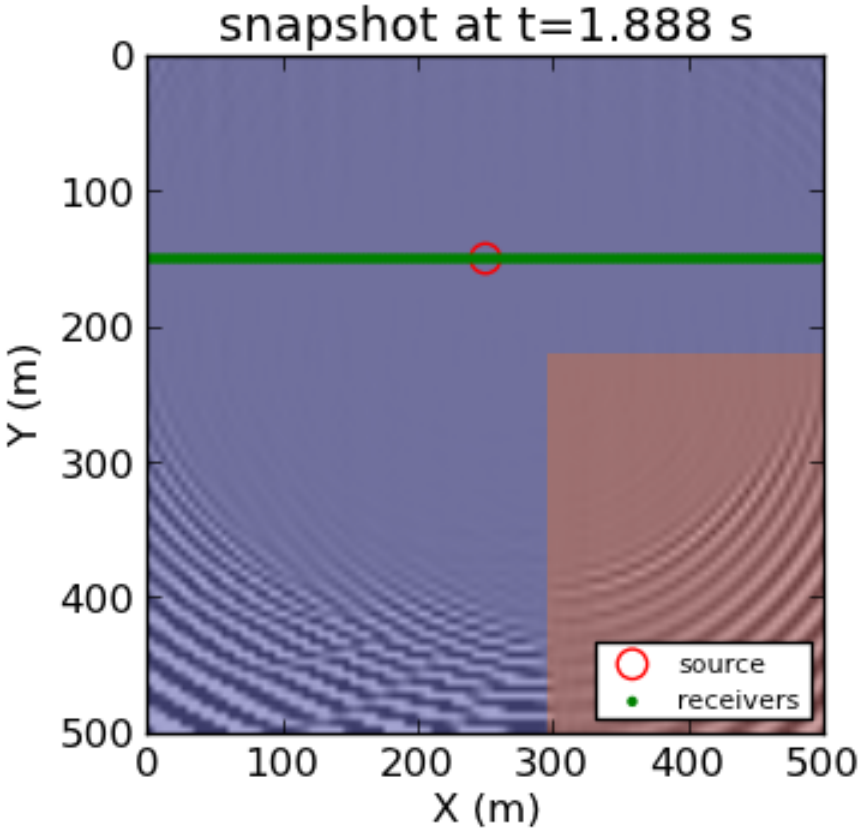
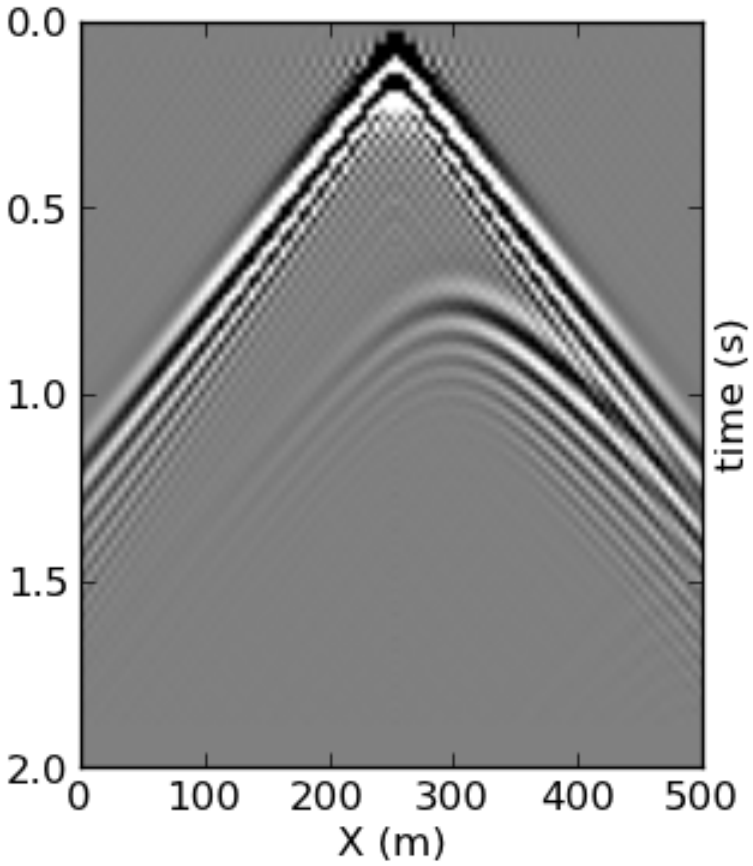
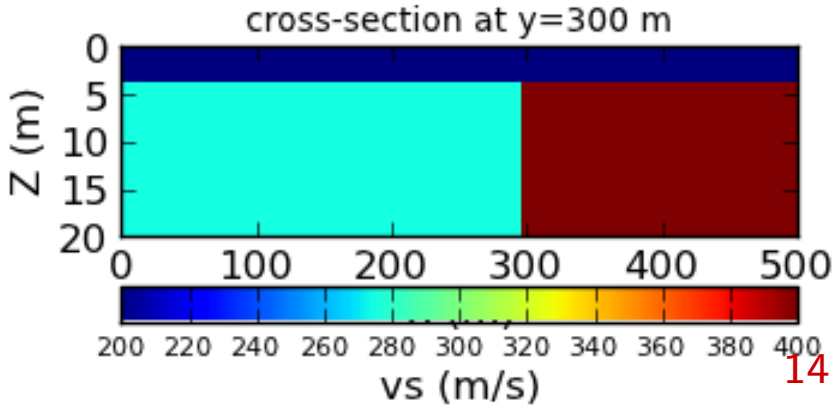


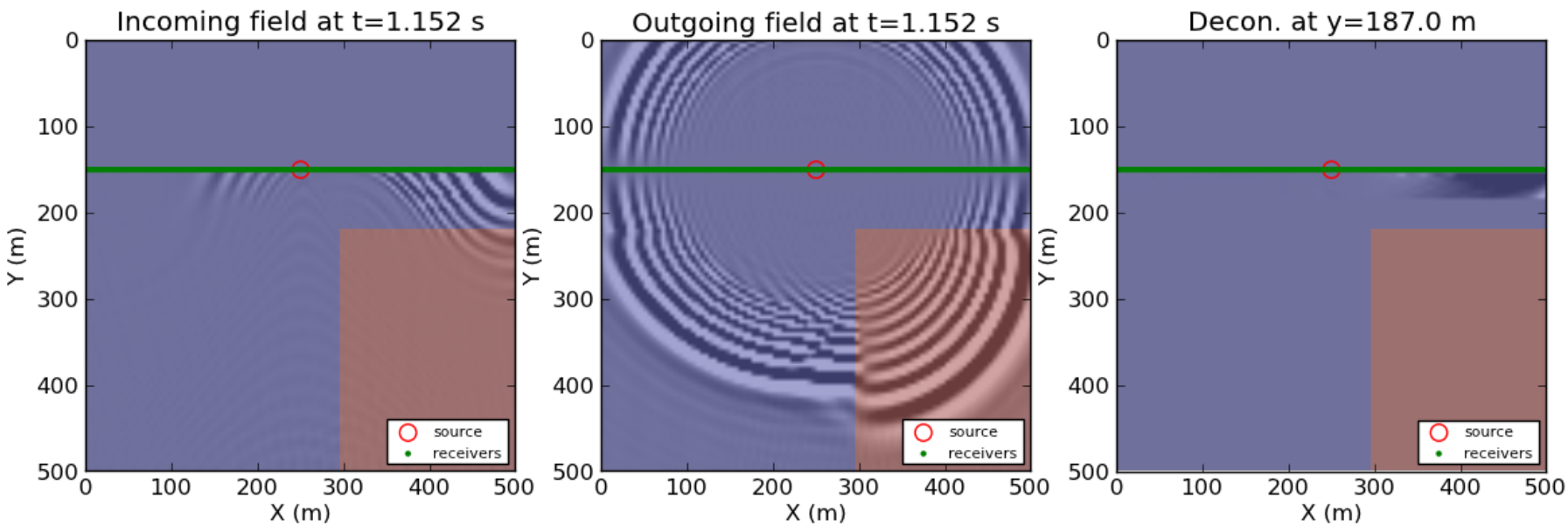




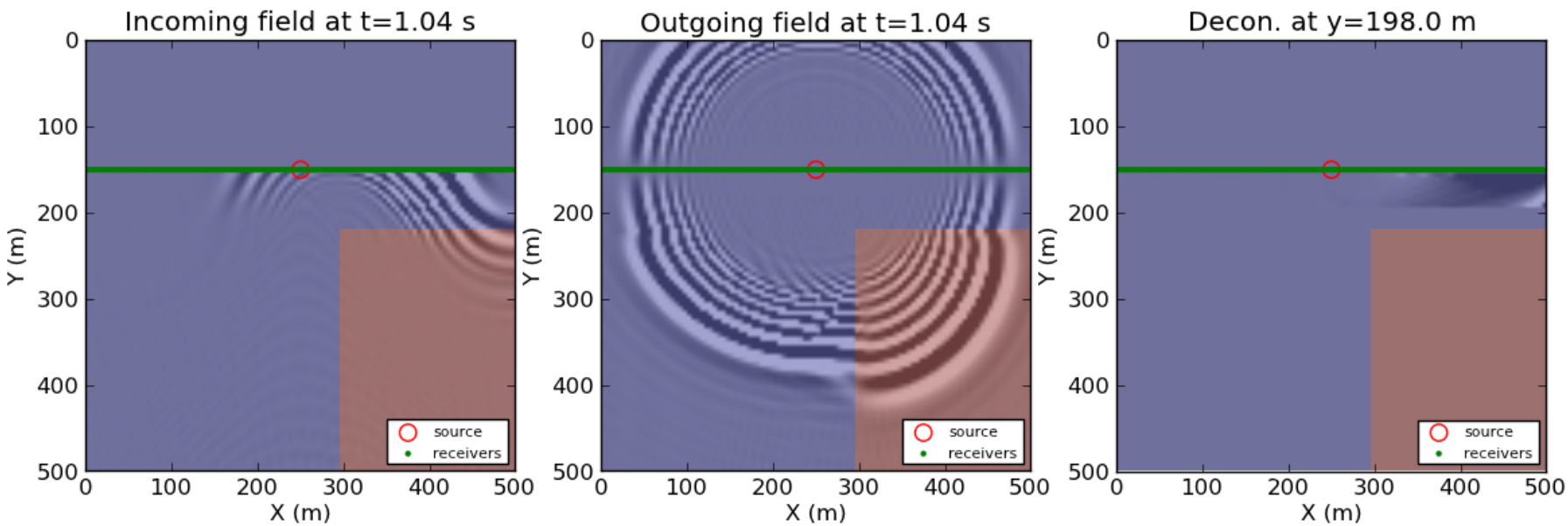
Ground-roll migration

- One-way split-step phase-shift (Stoffa, 90)
  - 2D X-Y (propagation in Y)
  - Modified for dispersion
  - Imaging condition - deconvolution

Ground-roll migration



Ground-roll migration



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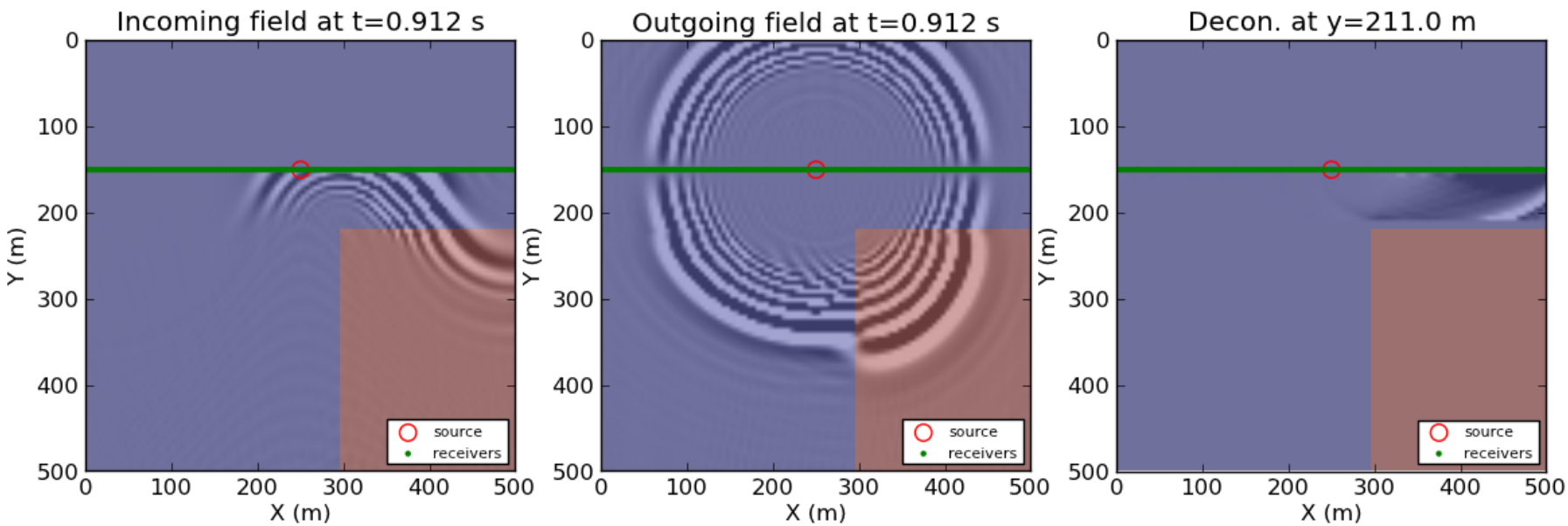

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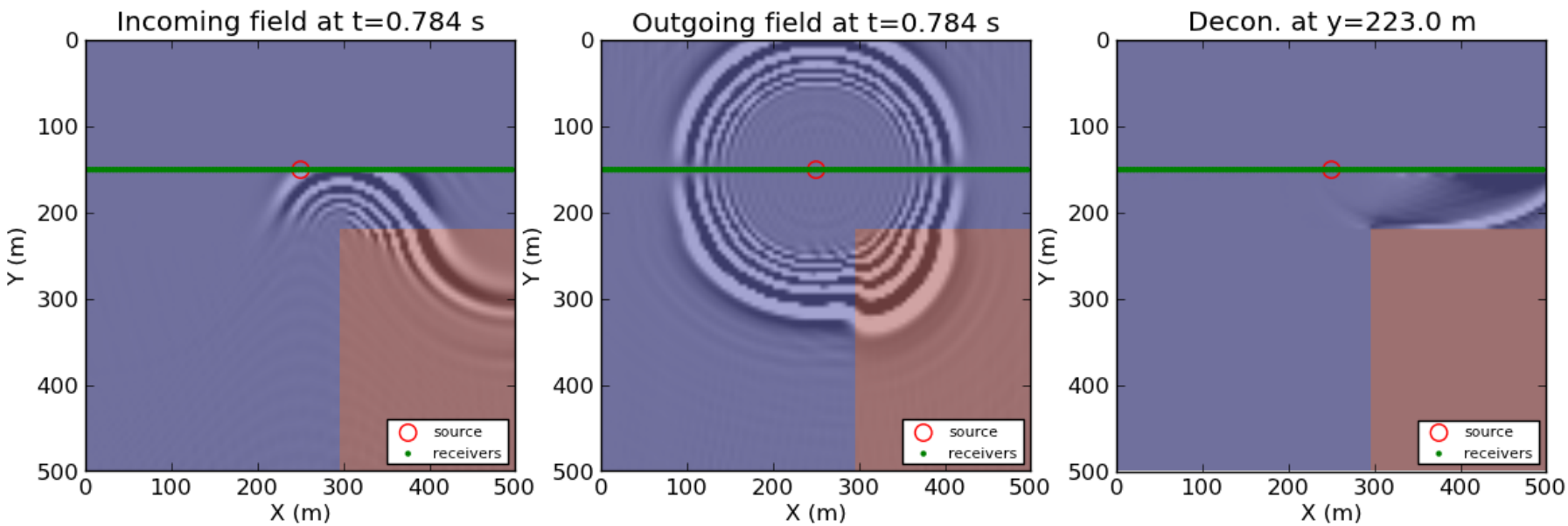
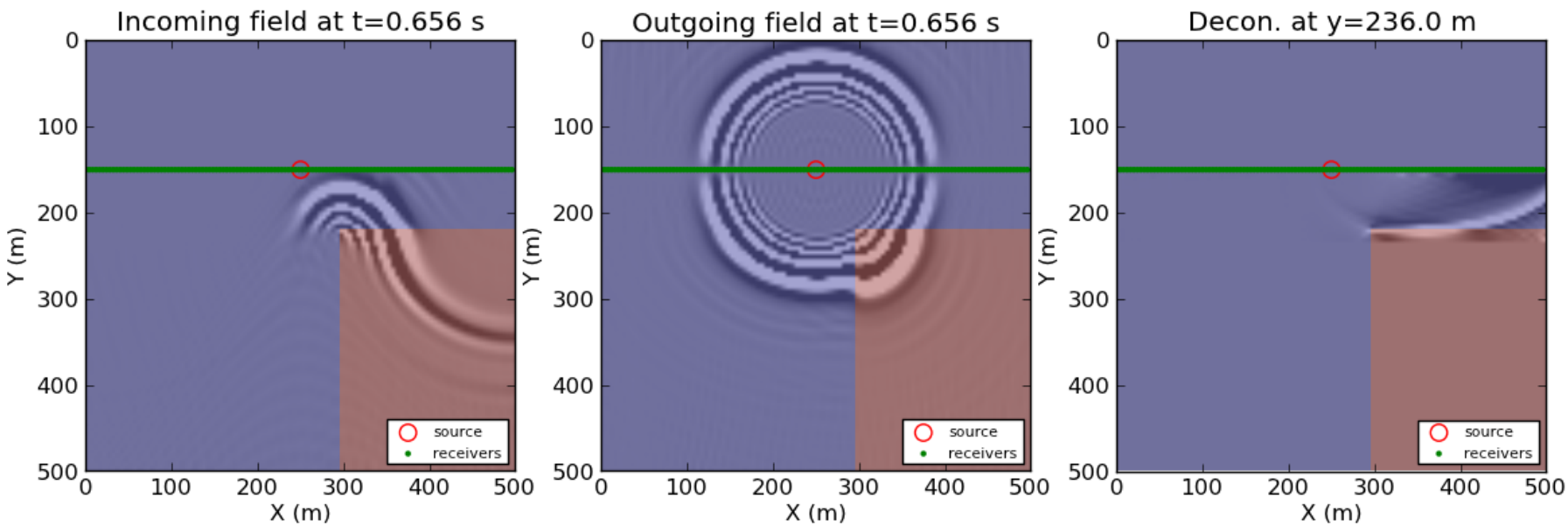
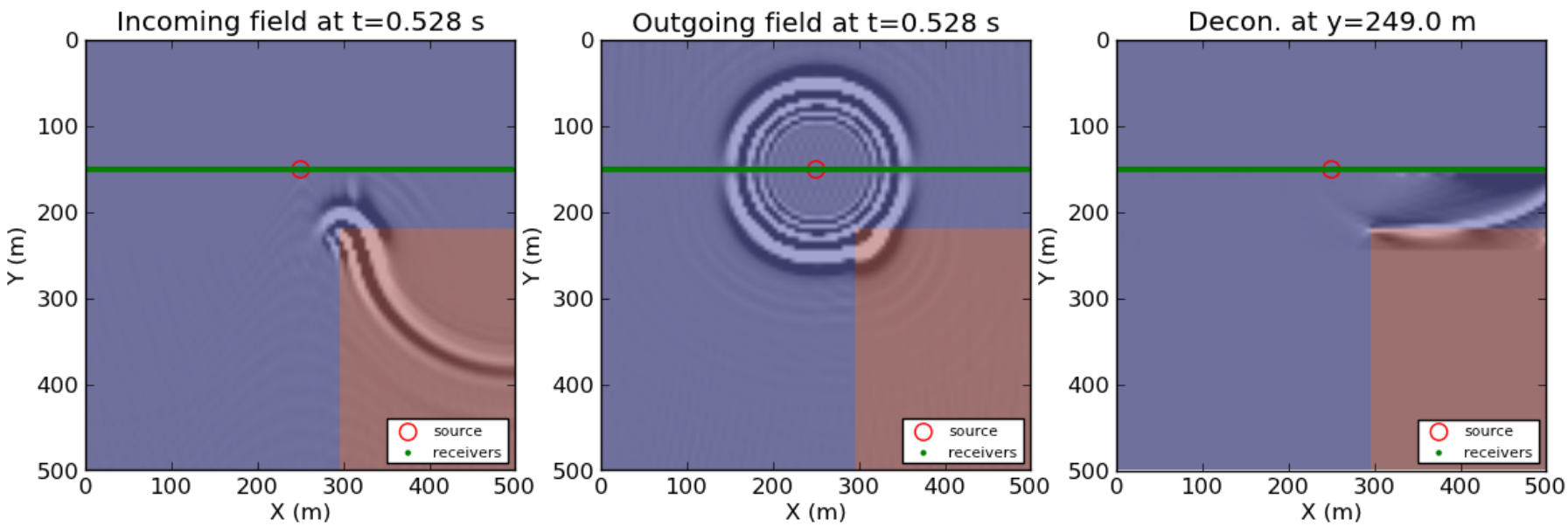


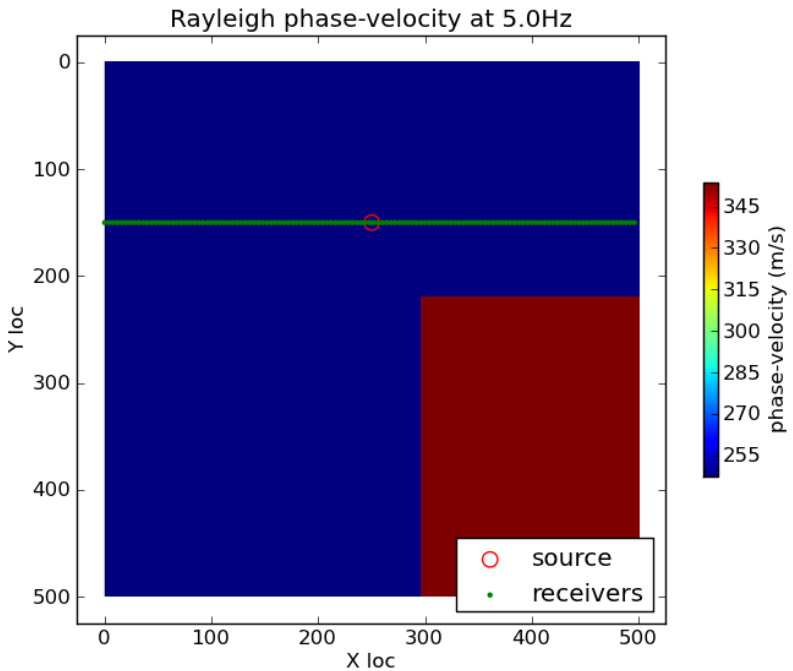
Ground-roll migration

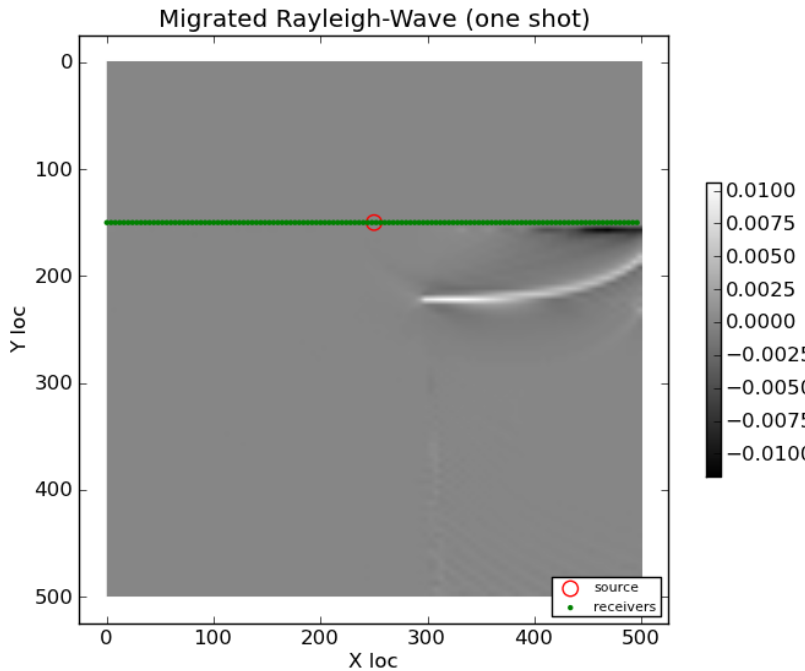


Ground-roll migration



Ground-roll migration





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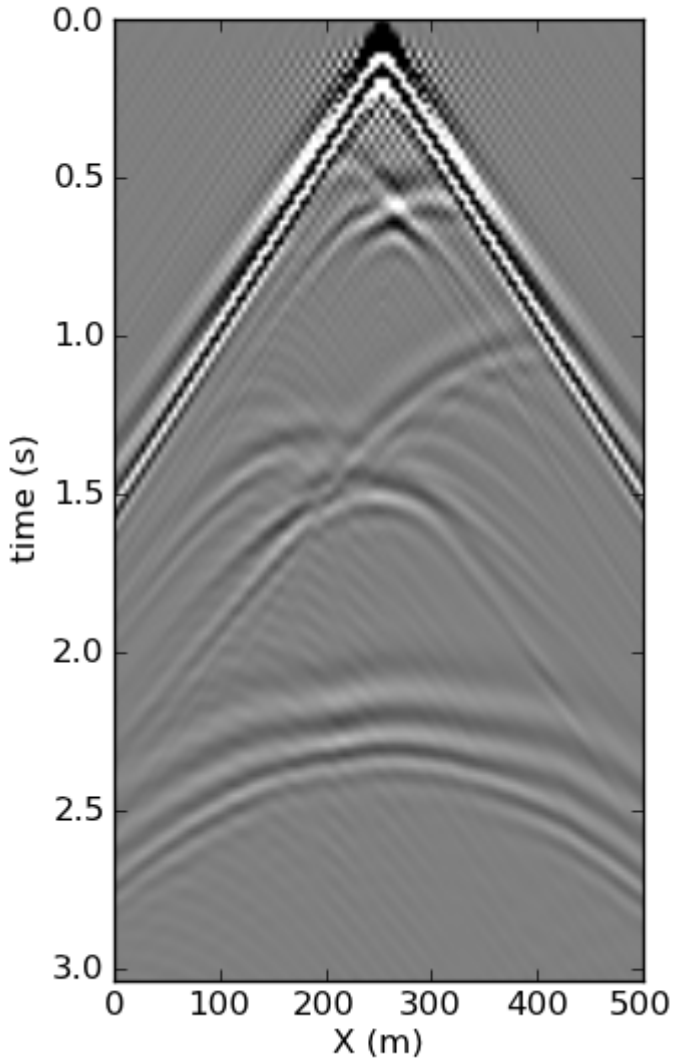

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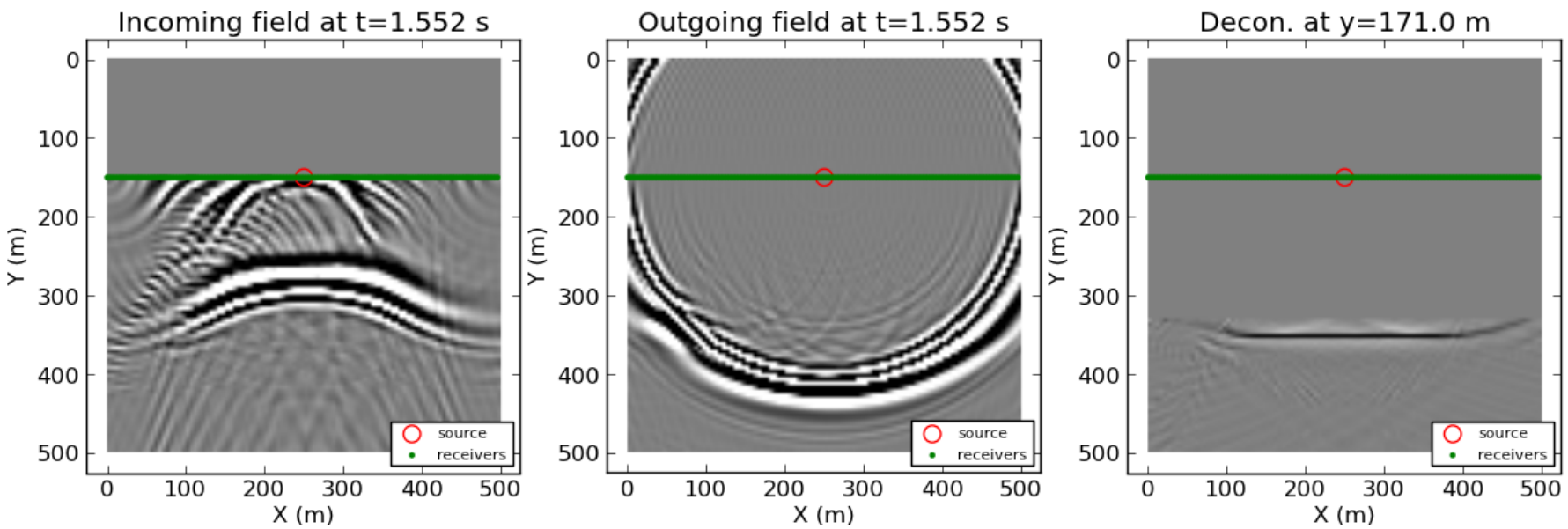

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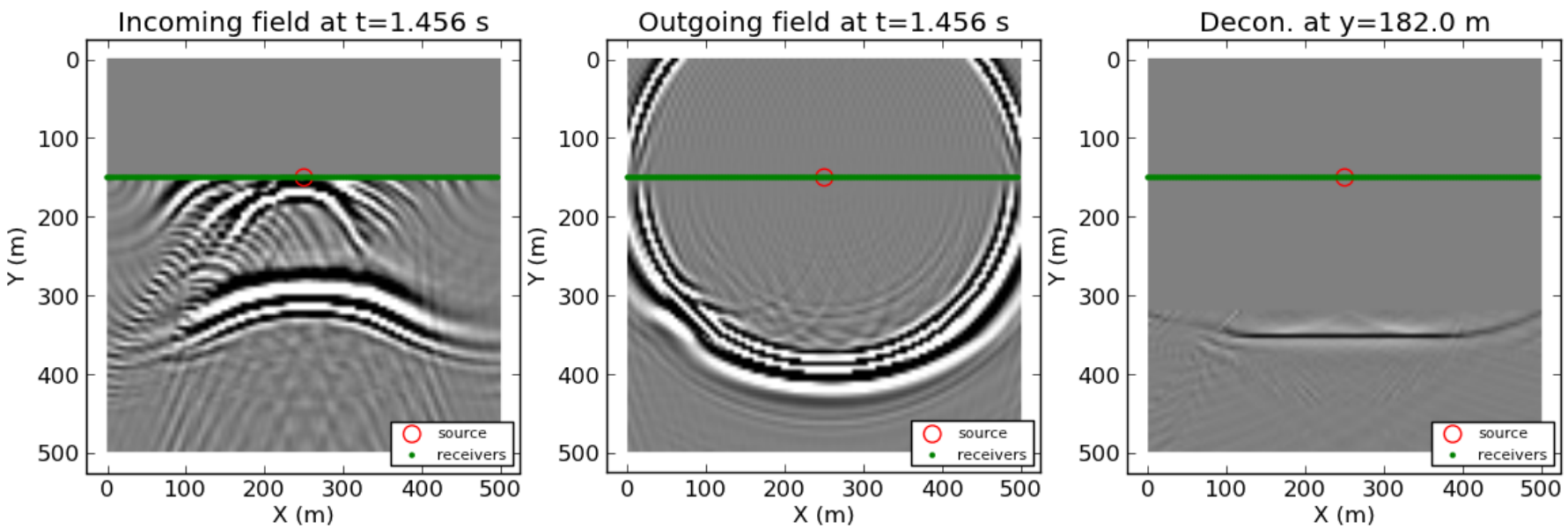

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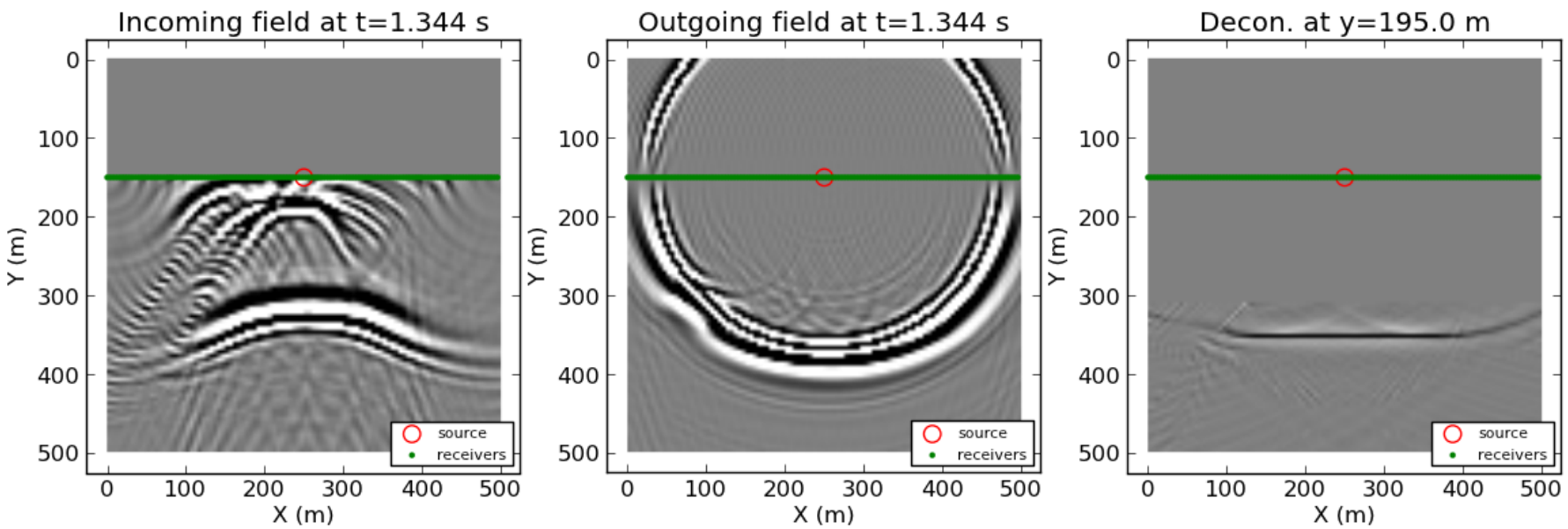

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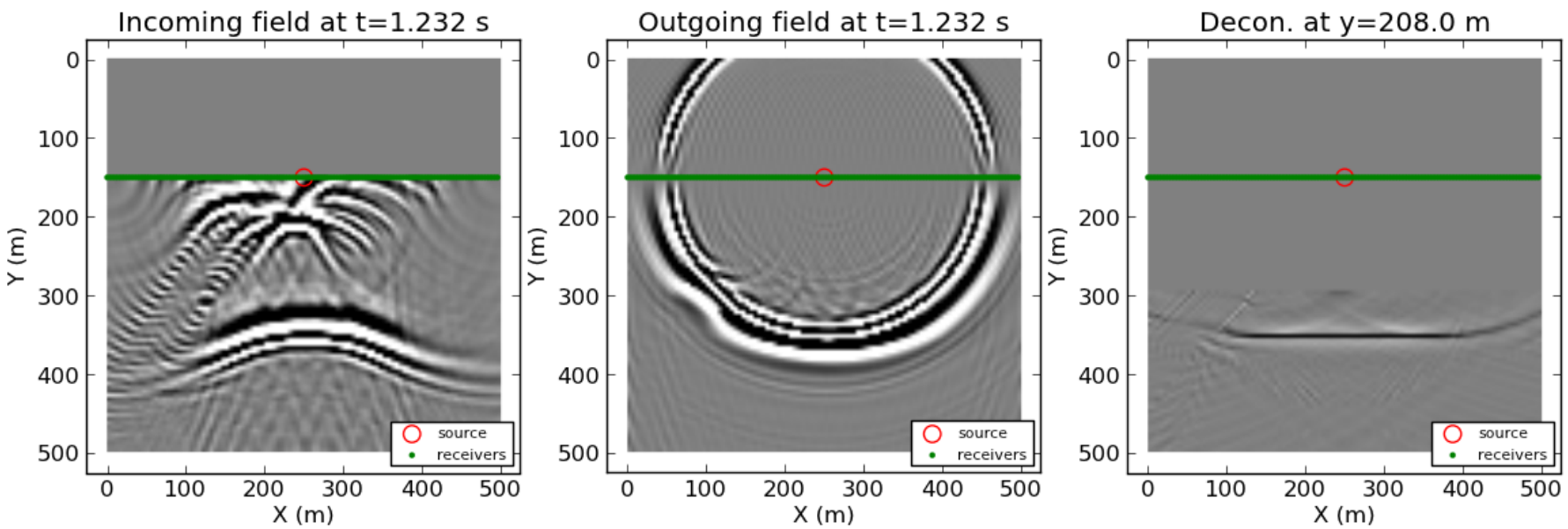

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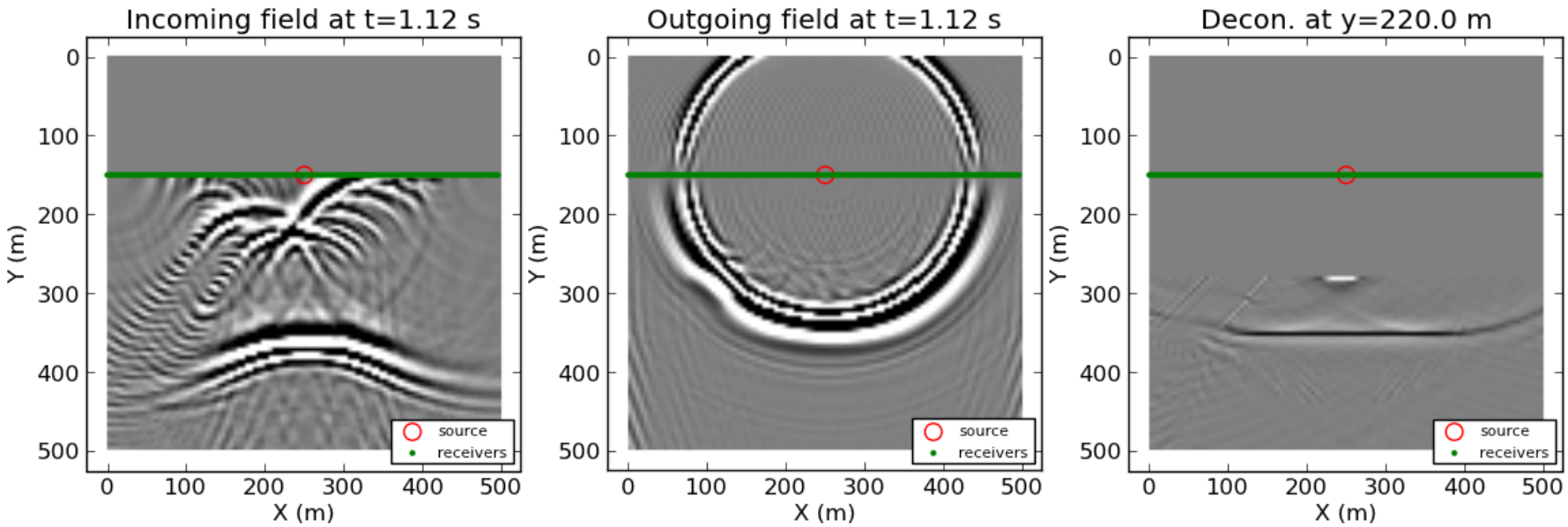

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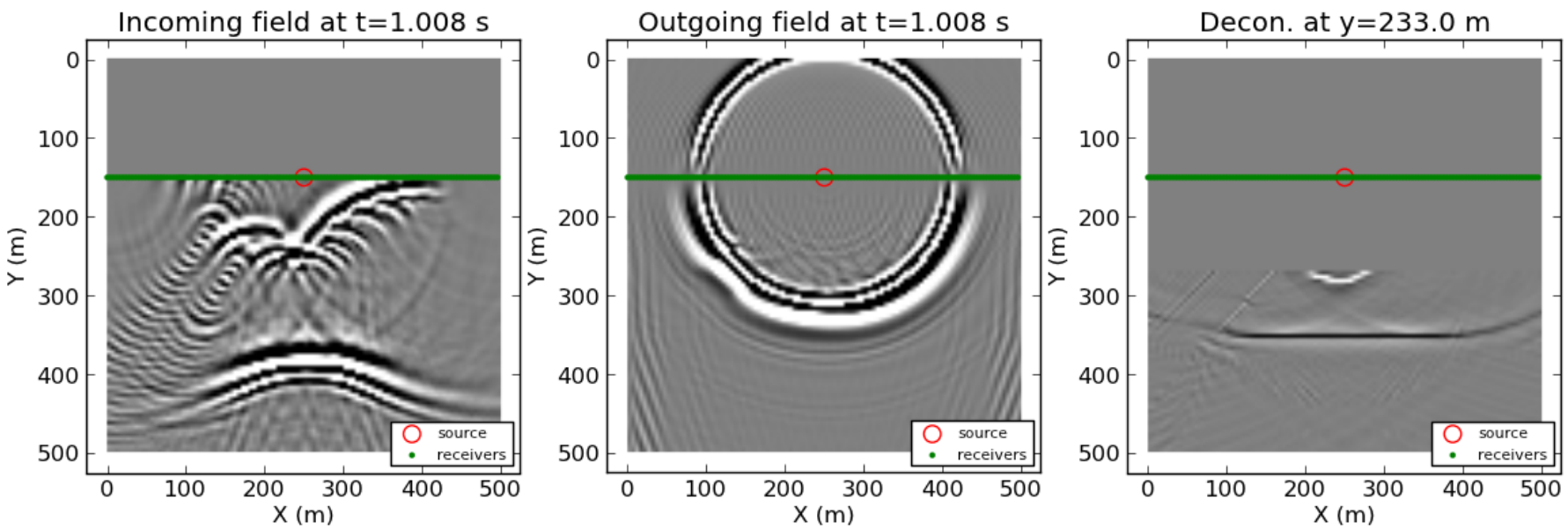

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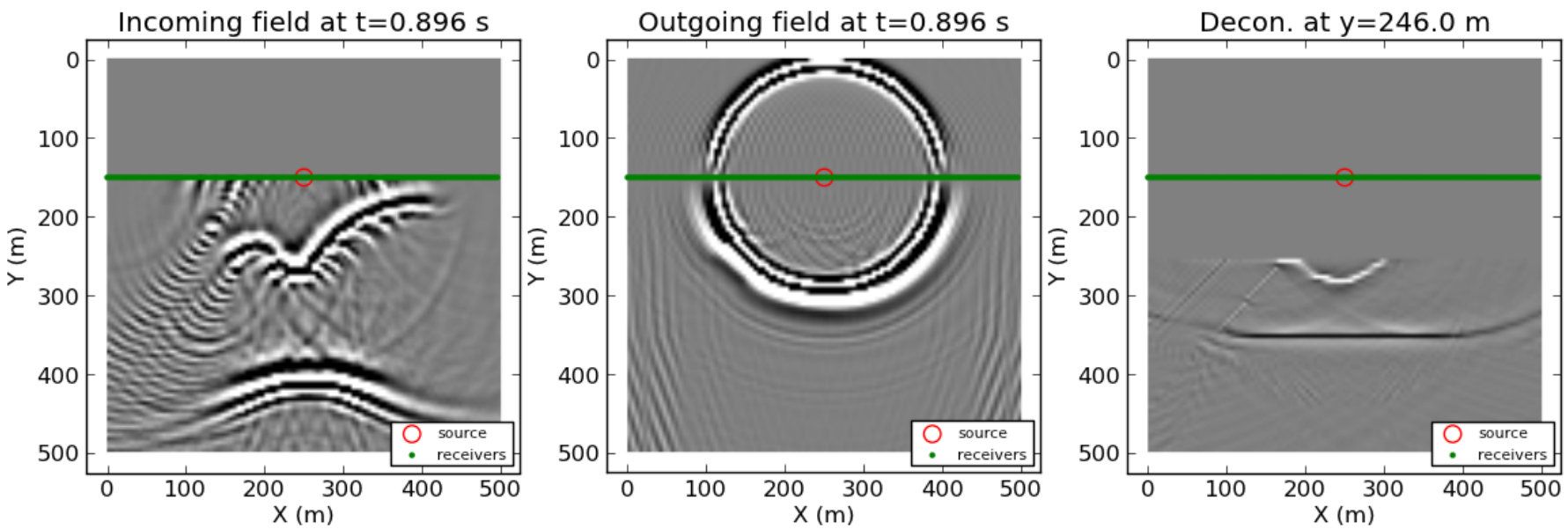

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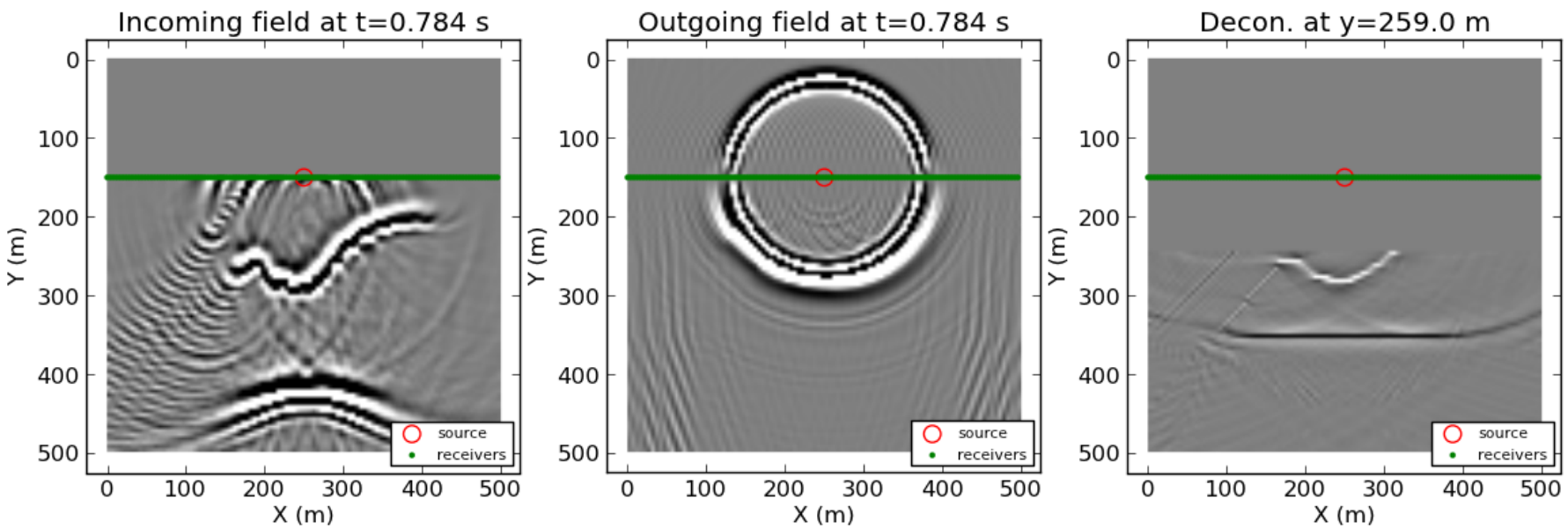

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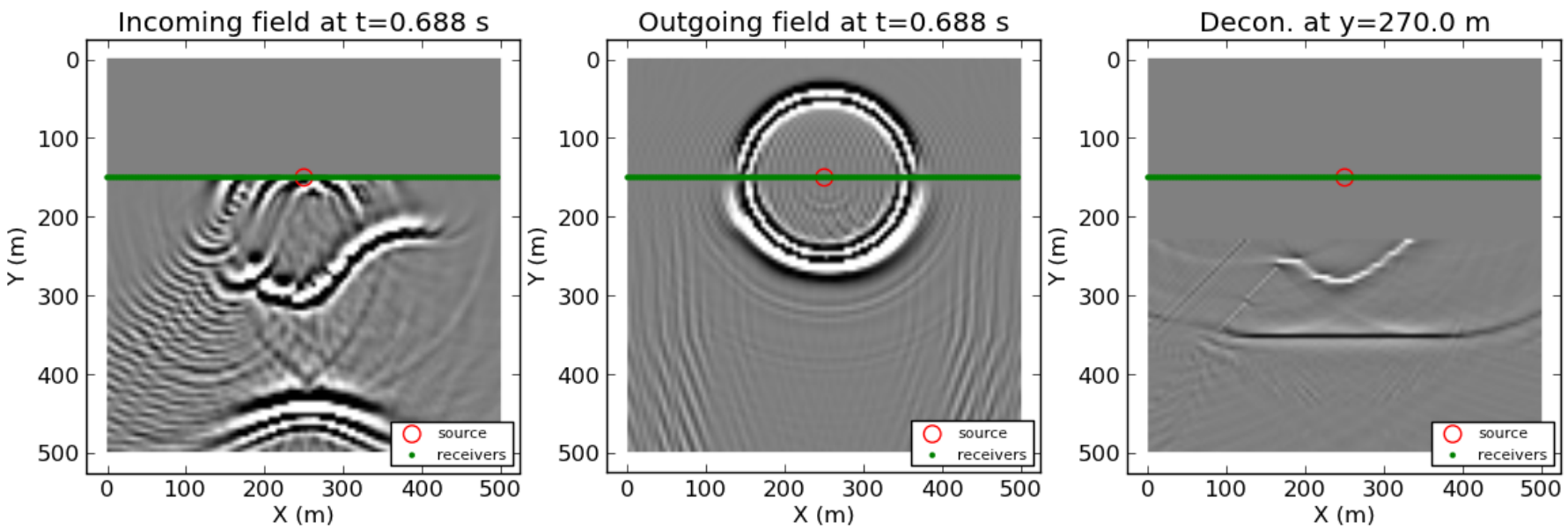

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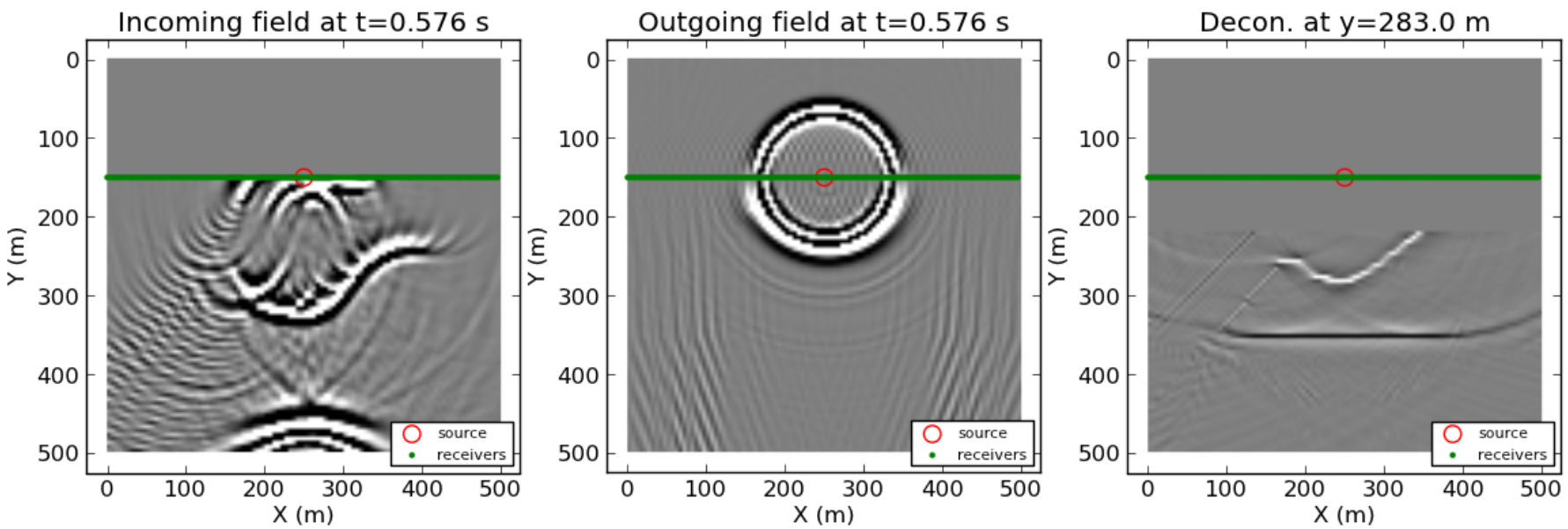

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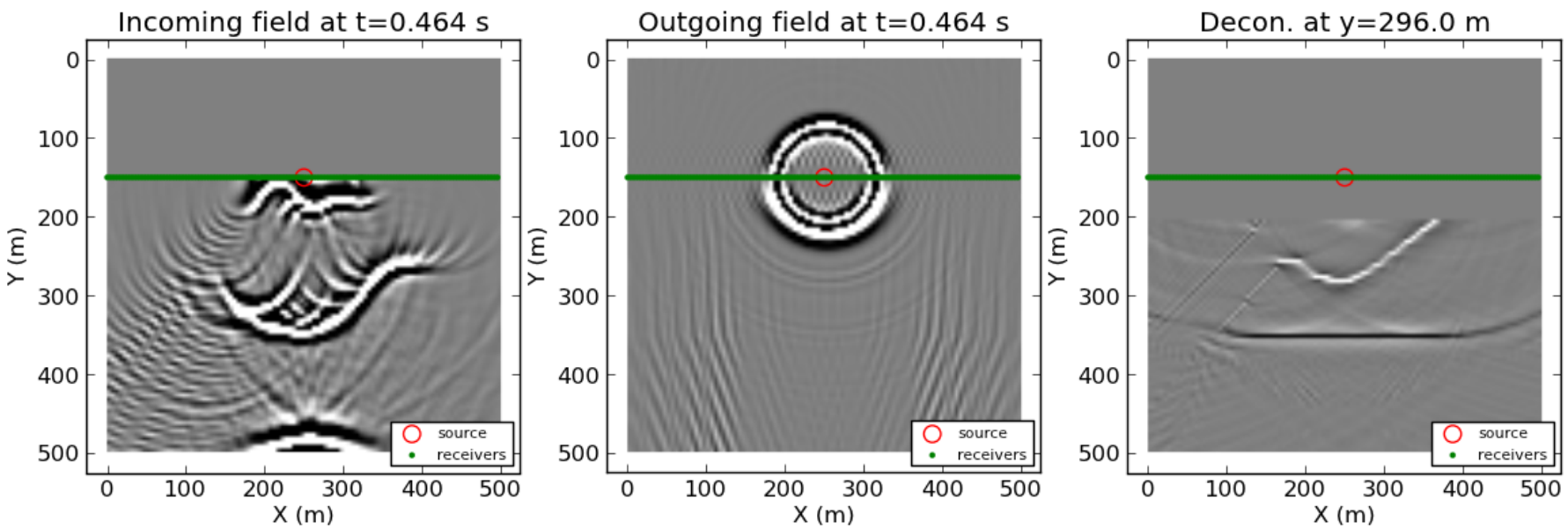

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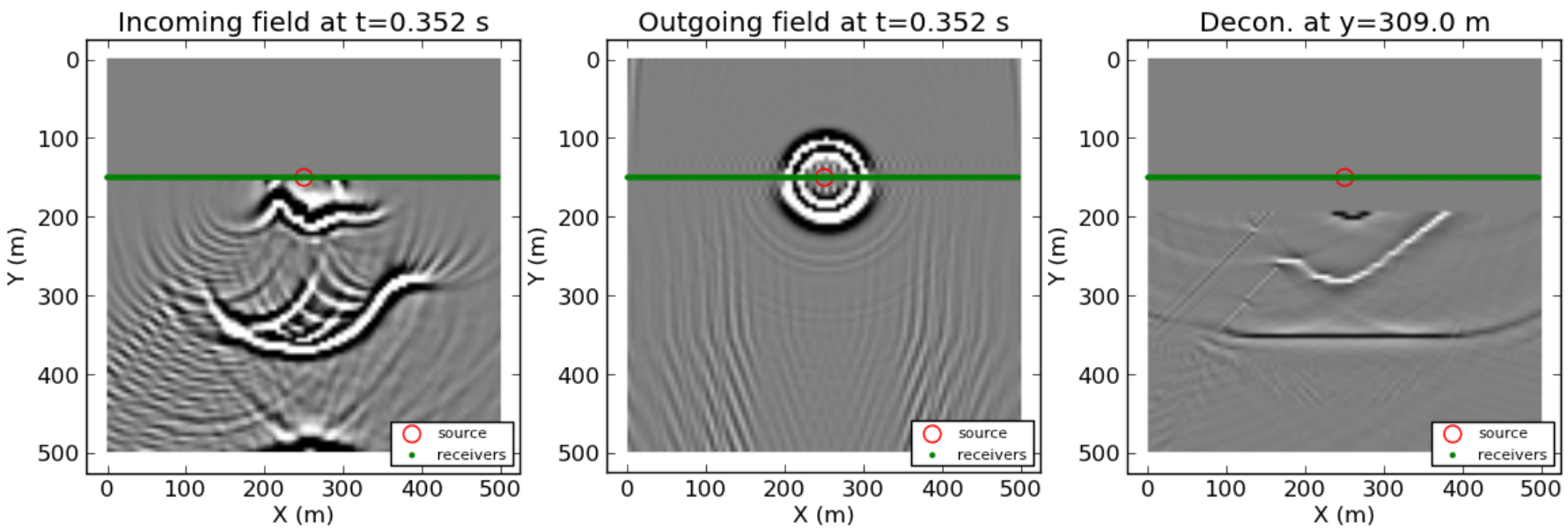

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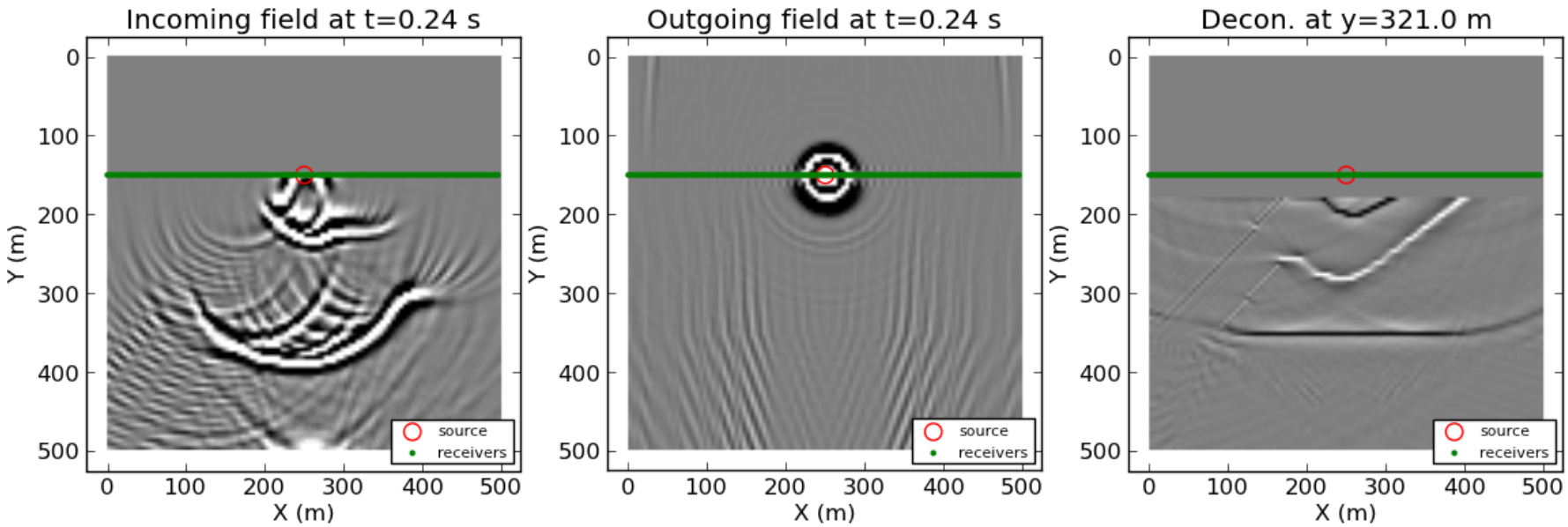

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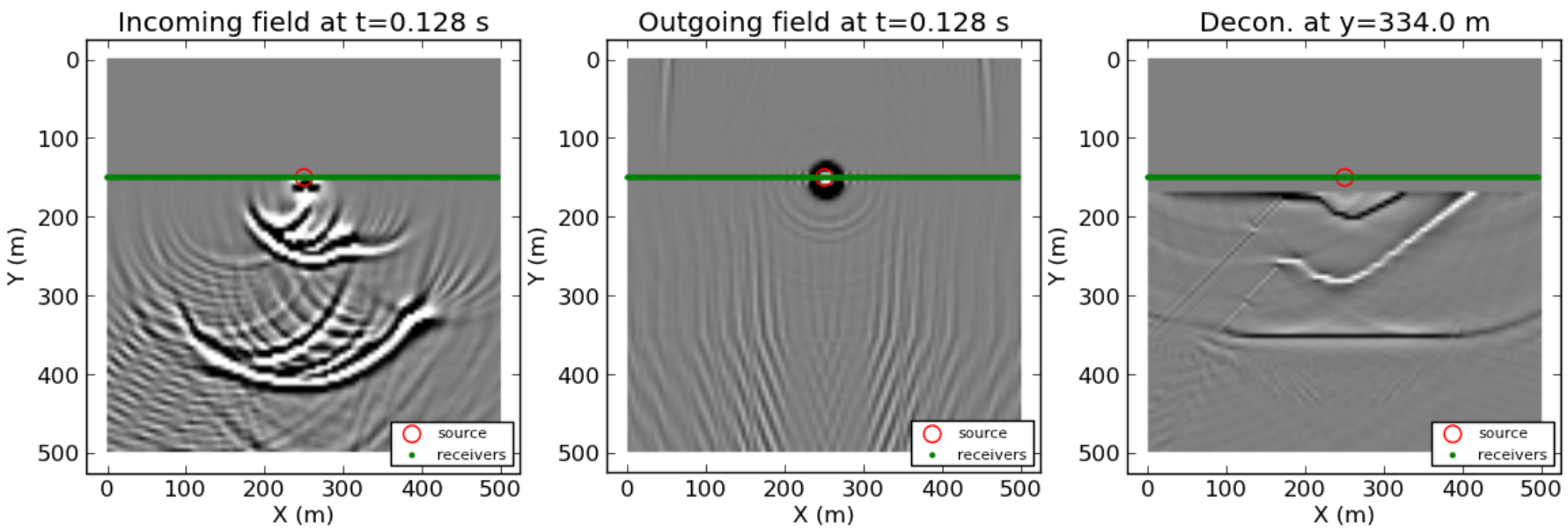

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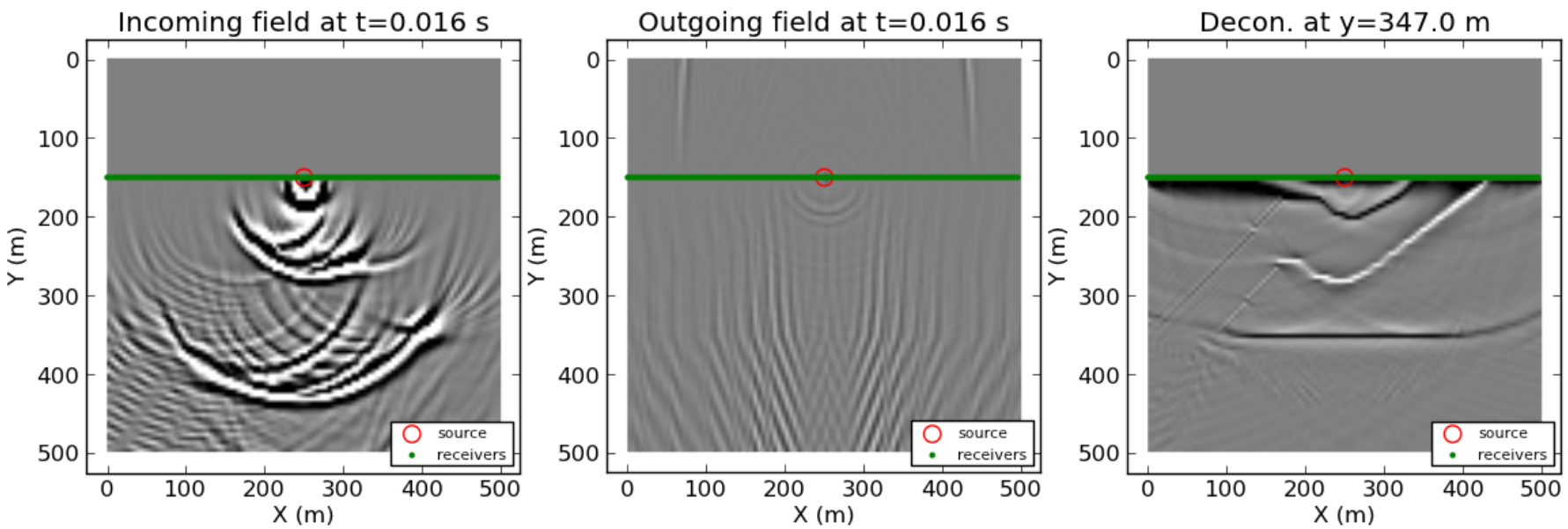
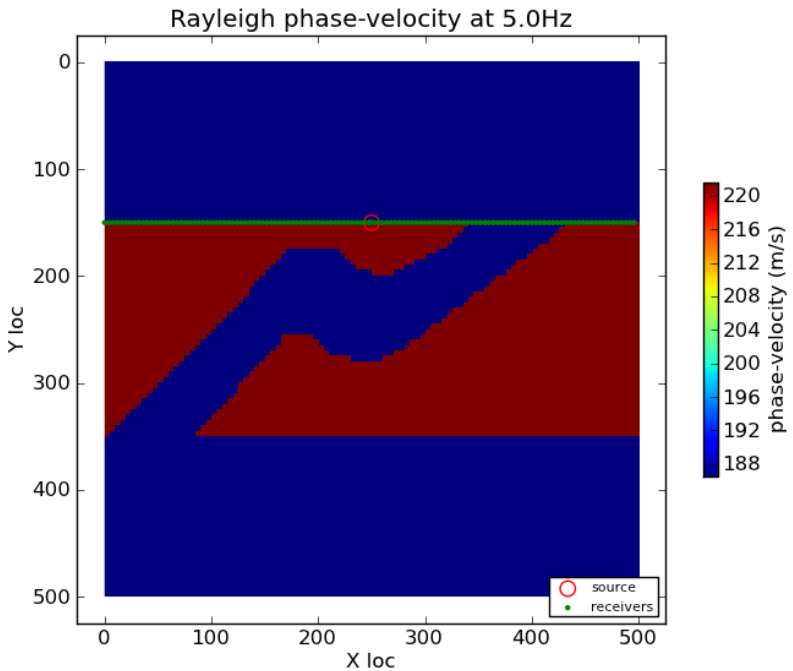
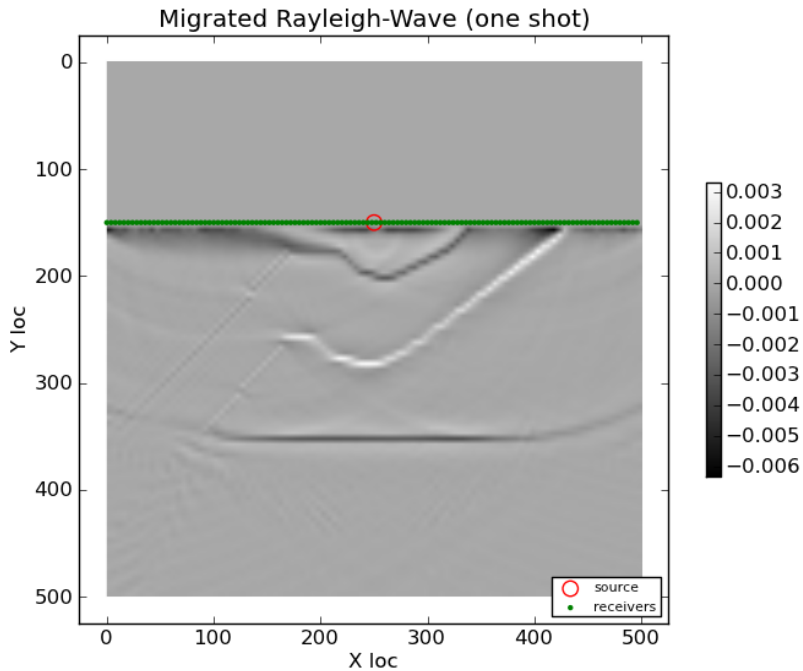


Depth imaging



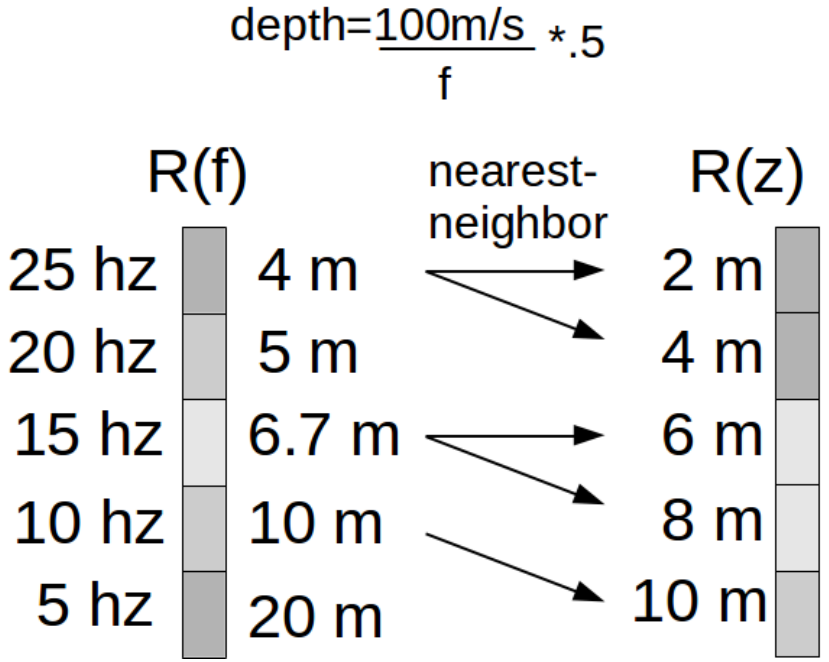


Summary

- Near-surface is important to define.
  - Identifying faults.
  - Determining statics.
  - Designing filters.
- Useful information in back-reflected ground-roll.
  - Defines sharp lateral heterogeneity.
  - Frequency content adds depth dimension.
  - Deconvolution is effective in imaging faults from ground-roll.

Thank you

Frequency-to-depth: Mapping

Theory

Surface waves are most sensitive to the velocity structure at one-half the wavelength of the surface wave (Rix et. al., 1989). Likewise, surface waves are also most sensitive to reflectivity of the structure at one-half the wavelength.